THE OCCURRENCE OF ALUMINIUM

IN

VEGETABLE PRODUCTS, ANIMAL PRODUCTS,

AND

NATURAL WATERS.

A CONTRIBUTION TO THE BIBLIOGRAPHY OF THE SUBJECT.

BY

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INTRODUCTION.

The material included in this contribution to the bibliography of aluminium deals only with the occurrence of this element in vegetable products, animal products, natural waters, and a few miscellaneous materials, such as edible earths. The general purpose has been to include only reference to such articles as report separate determinations of aluminium or some of its salts, and to omit the very large number in which iron and aluminium are reported together. In a few cases analyses have been cited which report "traces" of aluminium, but the bulk of this material also has been omitted. In older investigations, particularly those dealing with the mineral constituents of plants, data regarding aluminium are more abundant than in later works, and doubtless some of the aluminium reported came from impure reagents, from dirt contaminating the sample, or some similar cause. Such a criticism would not be limited to the constituent under consideration, but applies more or less, in principle at least, to many of the determinations included in early analytical work. The greater part of the material included in the compilation does not seem open to that objection, for, as time has progressed, analytical methods and chemical manipulations have improved, and there is no reason why determinations of aluminium made within recent years should not be fairly good.

No attempt has been made to comment on the value of individual analyses cited, as the object of this bibliography was the collection of data rather than the critical examination of them.

In collecting the data, a systematic search has been made of the files of the Journal of the London Chemical Society, The American Journal of Pharmacy, The Analyst, Jahresbericht der Thier-Chemie, Jahresbericht der Agricultur-Chemie, Just's Botanischer Jahresbericht, Chemical News, Zeitschrift für Untersuchung der Nahrungs- und Genussmittel, Experiment Station Record, the later volumes of the Comptes Rendus, de l'Académie des Sciences, Paris, Zeitschrift für Physiologische Chemie, the bulletins and other publications of the United States Geological Survey, and the reports of the Geological Survey of Canada, as well as numerous scientific journals, bulletins and reports of the Agricultural Experiment Stations, reports of State Boards of Geology and of Agriculture, and miscellaneous volumes on chemistry, mineral .waters, foods, and other topics, including such works as Wolff's "Aschen-Analysen von Landwirtschaftlichen Producten, Fabrik-Ausfällen, und Wildwachsenden Pflanzen," König's "Chemie der Menschlichen Nahrungs- und Genussmittel," etc.

In a great many instances the data found in a periodical or work of reference have been verified in the original publication and so cited. All possible precautions have been taken to insure accuracy, but those who have engaged in similar work know how difficult it is to eliminate all error.

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ALUMINIUM IN VEGETABLE PRODUCTS.

Aderholdt (Ann. Chem. u. Pharm., 82 (1852), p. 111) reports 6.1 per cent ash in the dry matter of a club moss (*Lycopodium chamaecyparissus*) gathered in March, of which 51.85 per cent was said to be Al_2O_3, and 57.364 per cent Al_2O_3 in the ash (4.5 per cent total) of a sample gathered in November. A club moss (*L. clavatum*) was found to contain in dry matter 4.7 per cent ash, 26.65 per cent being alumina. No alumina was found in other plants of the same region (near Bonn), such as oak, fir, and beech.

Allen, A. H. (Analyst, 13 (1888), p. 41; Jour. Chem. Soc. London, 54 (1888), p. 631), concedes on the statements of analysts that aluminium is present in minute proportions as a normal constituent of wheat, the amount corresponding to about 8 grains of alum in a four-pound loaf of bread. A method for determining the alumina present is proposed.

Andreasch, R. (Jour. Prakt. Chem., n. ser., 18 (1878), pp. 204–207), studied the ash of different parts of the garden pink and rose. The following is quoted:

ALUMINIUM IN CERTAIN PLANTS.

	Total Ash.	Al_2O_3.
	Per Cent.	Per Cent.
Garden pink (*Dianthus caryophyllus*):		
Root	5.64	2.56
Stem	5.26	trace
Leaves	4.44	
Flower	5.59	
Garden rose (*Rosa remontana*):		
Root	2.04	trace
Stem	2.31	
Leaves	9.43	
Flowers	6.27	

Apoiger (Vierteljahressch. Prakt. Chem., 6, p. 481; Jahresb. Chem., 1857, p. 530) found 7.76 per cent ash in the seed of *Maesa pic'a* dried at 100°. This contained 0.98 per cent Al_2O_3.

Athenstaed, W. (Ber. Deut. Bot. Gesell., 3 (1885), p. 57; Just's Bot. Jahresbericht, 1885, pt. 1, p. 81), reports the ash analyses of a mixture of leaves, flowers, and fruit of Labrador tea (*Ledum palustre*) according to the method of Grandeau and Fresenius. The crude ash constituted 3.95 per cent of the total dry matter and of this 1.17 per cent was Al_2O_3. The pure ash constituted 2.77 per cent of the total dry matter and of this 1.67 per cent was Al_2O_3.

Baer, W. (Arch. Pharm., 2d ser., 66, p. 285; Pharm. Centbl., 1851, p. 826; Jahresb. Chem., 1851, p. 710, Tab's C and C, p. 708), reports in rape-seed (dry material) 6.98, 5.97, 5.93, and 4.58 per cent ash respectively, containing 0.56, 1.02, 0.60, and 0.49 per cent alumina respectively. He also reports 4.47 and 4.41 per cent total ash in rape-straw (dry material) with respectively 0.63 and 0.22 per cent alumina.

Bailey, E. H. S. (Trans. Kansas Acad. Sci., 11 (1887–8), p. 49), found that the ash of corn-cobs contained a "little over one per cent of ash," 2.02 per cent of this being Al_2O_3.

Bastin, E. S., and **H. Trimble** (Amer. Jour. Pharm., 69 (1897), pp. 90–97), in an article on North American Coniferæ, report that the bark of hemlock (*Tsuga canadensis*) (air-dry) contains 1.42 per cent ash. Alumina was a consituent of this; the amount not reported.

Baudrimont, E. (Jour. Pharm., 3d ser., 42, p. 388; Jahresb. Chem., 1862, p. 512), reports 23.28 per cent ash in eel-grass (*Zostera marina*). Of this 0.26 per cent was Al_2O_3.

Béchamp, A. (Compt. Rend. Acad. Sci. Paris, 73, p. 337; Jour. Chem. Soc. London, 24 (1871), p. 855), notes a trace of alumina in the ash of yeast· the total ash in the dry yeast being 9.730 per cent.

Bell, J. Carter (Analyst. 4 (1879), pp. 126–133), reports that in four analyses of flour called No. 2 Crown and ground from a mixture of English and California wheat, he found 0.021 and 0.017, 0.020 and 0.024 per cent respectively of aluminium phosphate. Five pounds was made into bread, the crumb containing, according to analyses, 0.011 per cent aluminium phosphate. A Russian and a Ghirka flour, which the author states were "coarse grains flours such as a good baker would not like to use," contained respectively 0.58 and

0.592 per cent ash, with 0.016 per cent aluminium phosphate in each case. Bread was made from 2.75 pounds of the Russian flour. The coarse brown loaf contained 0.010 per cent of aluminium phosphate. Other samples of flour were examined as follows (the ash content and aluminium phosphate content only being quoted)

ALUMINIUM PHOSPHATE IN FLOUR.

Kind of Flour.	Ash.	Aluminium Phosphate.
	Per Cent.	Per Cent.
1. One Crown flour	0.628	0.018
2. Two Crown flour	.604	.0204
3. Three Crown flour	.52	.009
4. Four Crown flour	.448	.007
5. Five Crown flour	.488	.005
6. White English wheat, 1877	.484	.004
7. Red English wheat, 1877	.438	.010
8. American spring wheat	.492	.013
9. American red winter wheat	.380	.007
10. Empress Hungarian	.368	.002
11. Residue flour, from 1, 2, 3 mixture of Crown	.476	.010
12. Bran flour	.488	.012
13. Exhaust flour	.610	.011
14. Russian flour	.580	.0162
15. Egyptian flour	.700	.0059
16. Ghirka flour	.592	.0163
17. Semolina flour	.440	.0062
18. Flour, English and foreign wheat. ⅗ English, ⅖ foreign, principally Californian	.400	.001
19. Straws, made in Salford	.672	.0023
20. Coarse flour, or seconds, containing bran	1.44	.0058
21 White flour made in Salford	.680	.0018
22. Peerless flour made by Banaman, Sherman & Co., Rochester, New York	.500	.001
23. Gilt Edge, made by Chase, Bristol and Bide, Rochester	.516	.0008
24. Californian flour	.480	.0078
25. White English, 1878	.368	.0049
26. Purchased in Salford	.....	.0015
27. Purchased in Salford	.....	.009
28. Two Crown flour, total produce of wheat—40 per cent Red English, 30 per cent Californian White 30 per cent Canadian White	.260	.0087
29. Bran flour from Two Crown Mixture	.76	.016
30. Two Crown flour, less 5 per cent bran flour	.26	.0106
31. P A. Campbell, San Francisco	.300	.004
32. J .F., Salem Mills, United States	.448	.004
33. Albany City Mills, United States	.520	.001

Thirty-two samples of bread purchased from bakers in Salford were analyzed, the crumb being used. The amount of moisture and aluminium phosphate follows:

ALUMINIUM PHOSPHATE IN BREAD.*

Kind of Bread.	Moisture.	Aluminium Phosphate.
	Per Cent.	Per Cent.
Sample No. 1	46.10	0.0030
Sample No. 2	45.00	.0067
Sample No. 3	45.50	.0037
Sample No. 4	40.30	.0022
Sample No. 5	40.50	.0030
Sample No. 6	46.00	.0046
Sample No. 7	44.50	.0034
Sample No. 8	46.00	.0082
Sample No. 9	46.00	.0040
Sample No. 10	45.50	.0031
Sample No. 11	46.50	.0052
Sample No. 12	46.00	.0050
Sample No. 13	46.00	.0057
Sample No. 14	46.00	.0026
Sample No. 15	46.20	.0028
Sample No. 16	47.50	.0045
Sample No. 17	46.50	.0043
Sample No. 18	49.50	.0032
Sample No. 19	47.50	.0064
Sample No. 20	46.50	.0037
Sample No. 21	47.20	.0042
Sample No. 22	46.50	.0068
Sample No. 23	45.50	.0064
Sample No. 24	46.00	.0066
Sample No. 25	45.30	.0052
Sample No. 26	46.20	.0044
Sample No. 27	44.50	.0038
Sample No. 28	44.00	.0058
Sample No. 29	45.50	.0044
Sample No. 30	44.50	.0048
Sample No. 31	44.00	.0042
Sample No. 32	46.00	.0058

The amount of aluminium phosphate found in some samples of bread which did not contain alum was as follows: 0.005, 0.004, 0.005, 0.003, 0.010, 0.010, 0.009, 0.010, 0.009, and 0.008 per cent.

* The inference is that these breads contained no added alum.

In the following table the amount of total moisture and aluminium phosphate in a number of samples of bread known to contain no added alum is quoted from more complete analyses reported by Bell.

ALUMINIUM PHOSPHATE IN BREAD.

Bread made from	Ash Moisture.	Aluminium Phosphate.
	Per Cent.	Per Cent.
One Crown flour	45.00	0.003
Two Crown flour	45.00	.011
Three Crown flour	40.00	.009
Four Crown flour	38.00	.004
Five Crown flour	36.50	.0022
White English wheat	36.90	.004
Red English wheat	39.50	.0053
Russian Flour	42.70	.0053
50 per cent English Red, 50 per cent Canadian White	42.50	.0082
Pure White Canadian	42.50	.0035
Canadian Semolina	43.90	.0032
50 per cent English Red, 50 per cent Semolina	43.00	.009
California flour	43.50	.0100
One Crown flour	46.50	.0031
Four Crown flour	45.00	.0053

The author states that in view of these results he thought it would be of interest to trace the aluminium from the wheat through the various milling products. He, therefore, had flour, bran, etc., especially prepared from wheat which he procured. From the analyses reported the ash content and aluminium phosphate are quoted as follows:

ALUMINIUM PHOSPHATE IN WHEAT AND ITS MILLING PRODUCTS.

Wheat and its Milling Products.	Ash.	Aluminium Phosphate.
	Per Cent.	Per Cent.
English wheat grown upon chalk soil	1.720	0.013
Bran (18.5 per cent of the wheat)	5.640	.016
Sharps (8.5 per cent of the wheat)	2.000	.017
One Crown flour (26 per cent of the wheat)	.500	.007
Four Crown flour (45 per cent of the wheat)	.368	.006

Bell, J. Carter (Analyst, 6 (1881), pp. 197–201), reports analyses of eleven grape-juices and of various samples of unfermented and other wines. Among other constituents, the aluminium phosphate was determined. The amount of this constituent and the total ash found in the different samples follows.

ALUMINIUM IN GRAPE-JUICE, FERMENTED AND UNFERMENTED WINES.

	Total Ash in 100 cc.	Aluminium Phosphate.
Pure Grape-juices.	Per Cent.	Per Cent.
Black English hot-house grapes	0.356	0.084
White English hot-house grapes	.331	.051
Almeira, 1879	.311	.160
Almeira, 1880	.258	.251
French cluster, 1878. Chiefly used in the production of ordinary wine	.273	.512
Portugese cluster, 1879. Purchased in England; juice expressed	.252	.433
Bordeaux, 1880. Mixture of Carbenet Sauvignion, Malbec, and Verdat	.298	.359
Oporto, 1880. "The Bastardo" from the Alta Douro	.261	1.020
Pineau (Champagne grape). From the Cot d'or...	.289	.653
Folly Blanc. (Cognac grape)	.266	1.178
Blanquette	.284	.760
Grenach No. 1	.291	.789
Grenach No. 2	.289	1.795
Grenache	.305	3.850
Clairette	.348	2.582
Congress (from Vineland, N. J.)	.395	.220
Madeira Videilho	.267	.642
Madeira Tinta	.318	.431
Fermented and Unfermented Wines.		
"Bell's unfermented juice of the vine," pure, uncolored fruit	.033	2.085
Unfermented sherry	.030	2.216
Unfermented port	.034	3.956
"——— new wine," free from alcohol; guaranteed fruit	.190	.518
Selected unfermented wine for communion service	.261	1.002
"Pure and unfermented fruit of the vine"	.342	1.244
Castle Tent, an unfermented sweet wine	.593	1.341
Castle Rota Tent. Similar to Castle Tent	.570	1.360
"Unfermented wine, free from alcohol, and unintoxicating"	.290	.492
Greek wine from island of Scio, "unfermented"	.368	.642
White grape wine, fermented, from island of Scio	.158	.377
Deidesheimer, pale alcoholic wine	.185	.971
Deidesheimer Aucolee, a pale alcoholic wine	.194	.684
Italian juice, from Palmi, Calabria	.347	.998

Bergstrand, C. F. ("Ofversicht K. Svenska Vetensk. Akad. Förhandl., 1875, pp. 27–37), studied the effect of Swedish soils, containing alum, on vegetation. When the soil contained 0.5 per cent alum, the common cultivated plants would not grow. Mountain raspberry (*Rubus articus*), however, grew and produced fine-tasting fruit. The entire plant when thus grown contained 4.68 per cent pure ash with 3.47 to 5.59 per cent Al_2O_3.

Berthelot and **G. André** (Compt. Rend. Acad. Sci. Paris, 120 (1895), p. 288, and Ann. Chim. Phys., 7th ser., 5 (1895), p. 429) report, among other data regarding the existence of alumina in plants, the following determinations: Carefully washed alfalfa roots, 0.127 gm. or 0.5 per cent of pure alumina, second sample 0.48 per cent; convolvulus roots, 0.0596 gm. or 0.4 per cent; Bermuda-grass roots, 0.011 gm. or 0.12 per cent; lupine leaves, 0.013 gm. or 0.037 per cent; and linden leaves, 0.0012 gm. or 0.0025 per cent.

"These results indicate that alumina is present in considerable amounts in plants with extensive root systems, but that it remains largely in the roots and is found in only minute quantities in the leaves."

Bevan, E. J., and **C. F. Cross** (Chem. News, 42 (1880), pp. 77, 91; Jahresb. Chem., 1880, p. 1064) report 0.6 to 2.0 per cent ash in jute fiber; of this, on an average, 5.51 per cent was Al_2O_3.

Bitto, B. von (Landw. Vers. Stat., 42 (1893), 369; Jour. Chem. Soc. London, 64 (1893), II, p. 546), notes 6.76 per cent ash in the whole fruit of red peppers (Capsicum), and 5.66 per cent in the husk of the ripe fruit; these contained respectively a trace and 0.22 per cent Al_2O_3.

Bitto, B. von (Landw. Vers. Stat., 46 (1895), p. 327), reports traces of Al_2O_3 in the ash of red-pepper fruit, "paprika."

Block, H. (Arch. Pharm., 226 (1888), p. 953), reports the ash content of the root, stem, and leaves of English ivy to be 6.34, 4.92, and 12.6 per cent, respectively, of the dry matter. Of this 0.371, 0.637, and 0.312 per cent, respectively, was made up of Al_2O_3. In this and a majority of similar analyses the other ash constituents are reported also.

Blythe, A. W. (Foods: Composition and Analysis. London, 1888, p. 177), is of the opinion that properly cleaned wheat contains no alumina. He believes, however, that particles of clay and sand from millstones find their way into flour, "and there is no second-class flour in commerce which does not contain some small percentage of alumina." He is of the opinion that the aluminium is present as silicate.

Bobierre (Barral. Jour. Agr., 1876, p. 175; Jahresb. Agr. Chem., 1875–76, p. 133) reports 0.35 per cent Al_2O_3 in the material remaining after breaking hemp.

Bondurant, C. S. (Amer. Jour. Pharm., 59 (1887), pp. 122–124), finds that the hydrangea (*Hydrangea arborescens*) contains 3.41 per cent ash, one of the constituents being aluminium (amount not stated).

Bondurant, C. S. (Amer. Jour. Pharm., 59 (1887), pp. 340–342), states that the leaves of coltsfoot (*Tussilago farfara*) contain 17.10 per cent ash, one of its constituents being aluminium (amount not stated).

Brandes, R. (Arch. Pharm., 2d ser., 75 (1853), p. 269; Pharm. Centbl., 1853, p. 739; Jahresb. Chem., 1853, p. 581), notes in roots of Russian, Chinese, old Austrian, and new Austrian rhubarb (air-dry) 18.2, 8.82, 5.8, and 5.54 per cent ash, containing respectively 0.008, 0.015, 0.060, and 0.015 per cent alumina. The Austrian roots were grown near Bilitz.

Brandt (Wittstein's Vierteljahressch., 13, p. 322; Jahresber. Agr. Chem., 1865, p. 108) finds that the best Rheinpfalz tobacco leaves contain 20.24 per cent ash. Of this 0.216 per cent was found to be Al_2O_3.

Bromeis (Ann. Landw., etc., 14, p. 2; Jour. Prakt. Chem., 48, p. 447; Pharm. Centbl., 1849, pp. 753, 769; Jahresb. Chem., 1849, p. 667 and Tab. B, p. 656) notes 2.10 per cent ash in peas (dry matter) from Frankenfelde. Of this 0.17 per cent was alumina.

Brown, L. P. (Amer. Chem. Jour., 11 (1889), p. 37; Jour. Chem. Soc. London, 56 (1889), p. 543), notes in the ash of tobacco screenings, composed of the small fragments of stems and leaves which, with the dust, are sifted from tobacco during manufacture 43.40 per cent total mineral matter. This contained 0.47 per cent Al_2O_3.

Browne, C. A., Jr. (Pennsylvania Dept. Agr. Bul., 58; Jour. Amer. Chem. Soc., 23 (1901), p. 869), reports 0.30 per cent ash in the flesh of ripe apple. This contained 0.80 per cent alumina.

Bunge, G. von (Ztschr. Biol., 41 (1901), p. 155), gives a detailed analysis of honey. It contains (when fresh) 0.0046 per cent Al_2O_3.

Clarkson, P. S. (Amer. Jour. Pharm., 59 (1887), pp. 277–278), reports upon an analysis of cocoa shells. The total ash amounted to 9.07 per cent. The author states that in addition to the usual constituents, it contained aluminium. He says:

"This element has not been reported in some analyses of the ash, but was found by Wanklyn in the ash of cacao."

Clinch, J. H. M. (Amer. Jour. Pharm., 56 (1884), p. 131), reports an analysis of the leaves of New Jersey tea (*Ceanothus americanus*). The dry leaves contained 10.9 per cent moisture and 5.31 per cent ash. This was made up, according to the author, of chlorides, sulphates, phosphates, and carbonates of potassium, calcium, magnesium, aluminium, etc. with silicates.

Colby, G. E. (California Station Rpt., 1898–1901, pt. II, p. 252), reports analyses of hops grown in California. Ukiah hops contained 5.80 per cent ash and Wheatland hops 8.65 per cent. The ash contained respectively 2.15 and 2.16 per cent $Al_2O_3.Fe_2O_3$. The Wheatland hop soil (fine earth) contained from 6.24 to 15.42 per cent Fe_2O_3 and from 2.57 to 9.79 per cent Al_2O_3 according to analyses made by F. J. Snow.

Coppola, M. (Gaz. Chim. Ital., 10, p. 9; Jour. Chem. Soc. London, 37 (1880), p. 382), found 11.16 per cent ash in *Stereocaulon vesuvianum*. Of this 11.13 per cent was Al_2O_3.

Chassevent, A., and **C. Richet** (Compt. Rend. Acad. Sci. Paris, 117 (1893), p. 673; Jour. Chem. Soc. London, 66 (1894), II, p. 63), in a paper on the influences of metallic salts on lactic fermentation, found that the order of toxicity of the metals studied was as follows: Mg, Li, Ca, Sr, Ba, Al, Mn, Fe, Pb, Zn, Cu, Cd, Pt, Hg, Ni, Au, and Co.

Chatin, A. (Compt. Rend. Acad. Sci. Paris, 110 (1890), p. 376; Jour. Chem. Soc. London, 58 (1890), p. 659), states that truffles, contain from 20.84 to 24.26 per cent dry matter with 5.62 to 9.88 ash. This contained traces of aluminium.

Church, A. H. (Chem. News, 30 (1874), p. 137, in a paper on the occurrence of aluminium in certain cryptogams), reports investigations on the aluminium content of a number of varieties. A summary follows.

ALUMINIUM IN CRYPTOGAMS.

Kind of Cryptogam.	Ash in Dry Plant.	Al_2O_3 in Ash.
	Per Cent.	Per Cent.
Club moss (*Lycopodium alpinum*	3.68	33.50
Club moss (*L. clavatum*)	2.80	15.24
Club moss (*L. selago*)	3.20	7.29
Selaginella martensii	11.66	0.26
S. spinulosa	3.44	none
Horsetail (*Equisetum maximum*)	20.02	none
Adder's tongue (*Ophiglossum vulgatum*)	8.25	none
Psilotum triquetrum	5.06	trace?

Church, A. H. (Jour. Botany, n. ser., 4 (1875), p. 169), reports that the ash of a club moss (*Lycopodium billardieri*) (5.46 per cent of the dry matter) contained no alumina. This he considered the first instance in which alumina has not been found in lycopodium ash.

Church, A. H. (Proc. Royal Soc. London, 44 (1888), p. 121), in an article on the occurrence of aluminium in certain vascular cryptogams discusses at length the occurrence of aluminium in plants and reports a number of analyses. The results follow.

ALUMINIUM IN CRYPTOGAMS.

Kind of Plant.	Ash in Dry Plant.	Al_2O_3 in Ash.
	Per Cent.	Per Cent.
Club moss (*Lycopodium cernuum*)	.....	16.09
Club moss (*Lycopodium phlegmaria*)	4.08	0.45
Club moss (*L. billardieri*)	5.46	trace
Salvinia natans	16.82	1.86
Marsilea quadrifoliata	11.66	0.54
Tree fern, New Zealand	.....	19.65
Moss (*Cyathea serra*)	2.70	0.20
Fontinalis antipyretica	4.76	2.82

Quotations from the author's discussion follow.

"So far as the materials at one's disposal warrant any definite conclusions, it may, perhaps, be permissible to say that aluminium is a characteristic and abundant constituent of the ash of many, if not of all, the species of terrestrial Lycopodia; that it is absent from Selaginella and from a number of other allied vascular cryptogams; that it is present in notable quantity in at least one species of tree-fern though practically absent from others; and that it occurs in insignificant amount (like many other elements) in almost every plant in which its presence has been carefully sought for. As to the state of combination in which alumina exists in those plants in which it occurs in mere traces, we have very little information, but in the cereal grains and pulses it is probably in combination with phosphoric acid. In Lycopodia John states that aluminium acetate occurs, Ritthausen speaks of the malate, Arosenius of the tartrate. Anyhow, it is easy to extract abundance of an organic salt of aluminium by exhausting dried and pulverized *Lycopodium alpinum* with boiling water. So, in some cases, at least, the alumina present in these plants does not exist, as silica does in *Equisetum* and other highly silicious vegetable structures, in an insoluble form. As to the physiological function, if any, of this element, it is rash to offer an opinion. It is just possible that it may serve to some extent to neutralize the abundant organic acids of the plants in which it occurs, and thus assist, like the cognate element magnesium, in the metabolic processes of vegetation."

In a postscript to his paper he notes the occurrence of a very large quantity of alumina in the ash from the caudex of a tree-fern (*Alsophila australis*), from Tasmania; also more than mere traces of alumina in the ash of the caudex of *Dicksonia squarrosa.*

Councler, C. (Landw. Vers. Stat., 29 (1883), p. 241), compared the ash of the leaves of box elder (*Acer negundo*) grown by water-culture method and in soil. The former contained in dry matter 21.29 per cent ash; the latter, 13.29 per cent, with 0.0 and 4.00 per cent respectively of Al_2O_3.

Councler (Bot. Centralblatt, 40 (1889), p. 97, 129) reported the ash analyses of leaves of broad-leaved maple or sycamore (*Acer Pseudoplatanus*), gathered after they had fallen, lilac (*Syringa vulgaris*), beech-leaves, gentian (*Gentiana ciliata*), bloody eye (blut-auge) (*Adonis aestivalis*), club moss (*Lycopodium annotinum*), adder's-tongue (*Ophioglossum vulgatum*), carrot peel, winter rye seed, winter wheat seed, potatoes, stems, leaves, and fruit of mistletoe (*Viscum album*), twigs of Scotch pine (*Pinus sylvestris*), and pine twigs affected with mistletoe. In only one of these, namely, *Lycopodium annotinum*, was any aluminium found. The amount of this in the ash was 18.1 per cent.

Coupin, H. (Compt. Rend. Acad. Sci. Paris, 132 (1901), p. 645; Jour. Chem. Soc. London, 80 (1901), II, p. 335), in a study of the sensibility of higher plants to very feeble amounts of a number of mineral salts, notes that 1/50,000 $Al_2 (SO_4)_3$ in distilled water was toxic to wheat roots, the roots being injured by this and the other salts tested but not killed.

Crawfurd (Vierteljahressch. Prakt. Pharm., 6, p. 361; Chem. Centbl., 1857, p. 604; Jahresb. Chem., 1857, p. 530) notes 2.6 per cent ash in the seed of corn cockle (*Agrostemma githago*). Of this 1.17 per cent was Al_2O_3.

Cugini (Pharm. Jour. Trans., 3d ser., 7, p. 616; Jahresb. Chem., 1878, p. 940) regards alumina as one of the elements accidentally present in plants, and not as necessary for their growth.

Dafert, F. W. (Relatorio annual. Inst. Agron. Estado Sao Paulo et Campenia [Brazil], 1893; Jahresb. Agr. Chem., 1894, pp. 223–225), reports the ash analyses of a number of grasses. One of the panic grasses (*Panicum monostachyum*), cut just before blooming, contains 20.14 per cent pure ash in dry matter; of this 0.57 per cent was Al_2O_3. Tickle-grass (*Panicum capillare*) cut after blooming contained in the dry matter 8.52 per cent pure ash, with 2.23 per cent Al_2O_3 in it. The Al_2O_3 was not reported in the thirteen other varieties analyzed, but was included generally with the Fe_2O_3.

Damarçay, E. (Compt. Rend. Acad. Sci. Paris, 130 (1900), p. 91; Jour. Chem. Soc. London, 78 (1900), II, p. 235), states that the ash of Scotch fir, silver fir, vine, oak, poplar, and horn beam, when treated with boiling water, gives a solution from which hydrogen sulphide precipitates a brown material soluble in hydrochloric acid. When examined with a spectroscope such solutions showed the presence of several metals including a trace of aluminium.

Dambergis, A. K. (Oesterr. Chem. Ztg., 1 (1898), p. 479) reports the ash analyses of a number of sorts of Greek tobacco. The following is quoted:

ASH OF GREEK TOBACCO.

Kind of Tobacco.	Total Ash.	Al_2O_3.
Tobacco from	Per Cent.	Per Cent.
Aghias	18.75	0.187
Almyro	18.23	.177
Argos	16.02	.132
Arta	14.58	.151
Carditza	16.39	.100
Corinth	12.41	.102
Epidaure-Limira	16.37	.083
Curytanie	16.03	.131
Kalavrita	13.70	.098
Larissa	15.70	.114
Locrides	17.15	.156
Messi-Corfou	13.33	.148
Messolonghi	20.78	.177
Nauplia	21.03	.151
Oros	15.43	.140
Parnassus	18.55	.076
Pharsala	21.91	.134
Phthiotis	19.83	.180
Trikala	12.65	.105
Trichonia	24.69	.253
Tyrnavo	17.08	.142
Volto	16.29	.119
Volos	19.38	.177
Vonitza	20.61	.223
Xyrochorion	22.79	.188
Tumbek (*Nicotina persica*) from		
Argos	18.85	.212
Messolonghi	16.92	.154
Nauplia	18.34	.152
Phthiodis	13.13	.100
Trichonia	20.54	.169

Daubrawa (Vierteljahressch. Prakt. Pharm., 3, p. 337; Pharm. Centbl., 1854, p. 731; Jahresb. Chem., 1854, p. 659) found 12.12 per cent ash, containing 25.8 per cent carbon in shepherds' purse (*Capsella bursa pastoris*) (air-dry plant); without carbon, the Al_2O_3 content was 0.14 per cent.

Dieterich, E. (Vierteljahressch. Prakt. Pharm., 15, p. 196; Ztschr. Chem., 1866, p. 286; Chem. Centbl., 1867, p. 271; Bul. Soc. Chim., 2d ser., 7, p. 165; Jahresb. Chem. Will, 1866, p. 706), reports 3.02 per cent ash in the dry flesh of sweet chestnuts and 1.845 per cent in the shells, dried at 110°; of the former 0.090 per cent being Al_2O_3 and of the latter 5.793 per cent.

Doolittle, R. E., and **W. H. Hess** (Jour. Amer. Chem. Soc., 22 (1900), p. 218) note that the ash of cider vinegar should amount to not less than 0.25 per cent and that it contains a trace of aluminium.

Dunnington, F. P. (Jour. Amer. Chem. Soc., 2 (1880), p. 24), reports the ash constituents of eleven weeds. The plants were just about to bloom when gathered. They are as follows:

ALUMINIUM IN WEEDS.

Kind of Plant.	Pure Ash.	Al_2O_3.
	Per Cent.	Per Cent.
No. 1. Broom sedge (*Andropogon scoparius*)	2.24	0.20
No. 2. Wiregrass (*Eleusine Indica*)	2.45	0.22
No. 3. Blue thistle (*Echium vulgare*)	4.69	0.56
No. 4. Potato weed (*Solanum carolinense*)	2.17	0.11
No. 5. Purslane (*Portulaca oleracea*)	1.52	0.49
No. 6. Sumach (*Rhus glabra*)	1.48	1.15
No. 7. Sassafras (*S. officinale*)	1.41	1.26
No. 8. Ragweed (*Ambrosia artemisiæfolia*)	1.93	0.00
No. 9. Mullein (*Verbascum thapsus*)	1.01	1.15
No. 10. Dock (*Rumex obtusifolius*)*	1.60	0.45

The SiO_2, Al_2O_3, Fe_2O_3, and Mn_3O_4 reported are regarded as due to dust adhering to the plants analyzed.

Dupré, A. (Analyst, 4 (1879), p. 1), in a paper on the detection and estimation of aluminium in wheat flour, reports the examination of twelve samples of flour purchased from reputable bakers, in which alum could not be detected. A four-pound sample of each of these flours contained aluminium as follows:

No. 1, 0.63 grains; No. 2, 1.26 grains; No. 3, 1.80 grains; No. 4, 1.41 grains; No. 5, 2.30 grains; No. 6, 1.07 grains; No. 7, 1.62 grains; No. 8, 2.79 grains; No. 9, 2.79 grains; No. 10, 2.50 grains; No. 11, 2.05 grains, and No. 12, 3.72 grains.

Ebert, A. E. (Vierteljahressch. Prakt. Pharm., 17, p. 438; Jahrb. Chem. Will., 1868, p. 815), reports 51.476 per cent ash in

* An abstract of this investigation (Jahresber. Agr. Chem., 1882, p. 141) gives figures for the ash analysis of stickweed (*Verbesina siegesbeckia*), 3.53 per cent being the pure ash content and 0.15 per cent the Al_2O_3. No analyses of stickweed appear in the original publication.

the air-dry seeds of anatto (*Bixa orellana*). This contained 0.808 per cent alumina.

England, J. W. (Amer. Jour. Pharm., 55 (1883), p. 246), studied a myrtle (*Myrtus cheken*) and found 4.84 per cent ash in stems and 8.4 per cent in leaves. Both contained aluminium. The amount was not stated.

Enz (Vierteljahressch. Prakt. Pharm., 5, p. 196; Chem. Centbl., 1856, p. 393; Jahresb. Chem., 1856, p. 691) notes 1 per cent ash in the fresh berries of honeysuckle (*Lonicera xylosteum*). Of this 0.1 per cent was Al_2O_3.

Eylerts, C. (Vierteljahressch. Prakt. Pharm., 9, p. 529; Jahresb. Chem., 1860, p. 561), found 6.57 per cent ash in air-dry "German worm seed" (*Semen cinæ*), i.e. the unexpanded flower heads of wormwood (*Artemisia maritima var. Stechmanniana*). Of this 2.33 per cent was Al_2O_3.

Eylerts, C. (Arch. Pharm., 2d ser., 109, p. 105; Vierteljahressch. Prakt. Pharm., 11, p. 517; Chem. Centbl., 1862, p. 154; Jahresb. Chem., 1862, p. 512), reports the following in red beets:

Beets from Munich dried at 110°:

Root, total ash, 13. 4 per cent, Al_2O_3 in ash, 0.28 per cent; leaves, total ash, 20.86 per cent, Al_2O_3 in ash, 0.12 per cent.

Beets from Weyenstephen dried at 110°:

Root, total ash, 11.27 per cent, Al_2O_3 in ash, 0.25 per cent; leaves, total ash, 15.57 per cent, Al_2O_3 in ash, 1.99 per cent.

Falco, C. (Vierteljahressch. Prakt. Pharm., 15, p. 509; Chem. Centbl., 1867, p. 142; Jahresb. Chem. Will., 1866, p. 709), reports 8.3 per cent ash in the bark of *Petalostigma quadriloculare*, containing 0.047 per cent Al_2O_3.

Fraas, H. (Vierteljahressch. Prakt. Pharm., 15, p. 338; Jahresb. Chem. Will., 1866, p. 710), reports 3.149 per cent ash in the dry leaves of *Gastrolobium bilobum*, a leguminous plant of West Australia reported to be poisonous. Of this 1.145 per cent was Al_2O_3.

Frankforter, G. B. (Amer. Jour. Pharm., 69 (1897), p. 134), reports that poke-weed (*Phytolacca decandra*) root contains 13.38 per cent ash. Of this 1.62 per cent was Al_2O_3.

Fritsch, K. (Arch. Pharm., 3d ser., 27 (1889), p. 193), studied the ash constituents of several plants. A boletus (*Boletus edulis*) contained 9.20 per cent dry matter, of which 7.32 per cent was pure ash. Al_2O_3 constituted 0.02 per cent of the latter. The amount of pure ash in the dry matter (the amount not stated) of *Polysaccum pisocarpium* was 5.28 per cent. Of this Al_2O_3 constituted 1.35 per cent.

Gabba, L. (Trattato di analysi chimica, Vol. II, p. 514), in discussing the aluminium content of wine, reports that it does not occur in excess of 0.01 per cent. Ricciardi notes that he has demonstrated the occurrence of alumina in wine and has found 0.13 gm. in 479 gms. grape seed (equal to 0.0027 per cent).

Gasparin, P. v. (Barral. Jour. Agr., 2 (1875), p. 410; Jahresb. Agr. Chem., 1875–76, p. 139; Centbl. Agr. Chem., 8 (1875), p. 249), reports 1.375 per cent Al_2O_3 in soil and none in alfalfa.

Gaze, R. (Apoth. Ztg., 5 (1900), p. 9; Just's Bot. Jahresbericht., 1890, I, No. 1, p. 51), reports that the root of golden seal (*Hydrastis canadensis*), dried at 100°, contains 0.3259 per cent Al_2O_3.

Glenk, R. (Amer. Jour. Pharm., 63 (1891), p. 328), reports a study of water-hemlock (*Cicuta maculata*). The fruit dried at 110° lost 10 per cent in weight. The ash amounted to 6 per cent and contained 20 per cent Al_2O_3.

Gmelin (Anorganische Chemie, 2, 1, p. 608) notes that the ash of wild plants often contains alumina, and cites the following: eel-grass (*Zostera marina*) 0.27 per cent; alga (*Cladophora glomerata*) 0.31 per cent; wormwood (*Artemisia maritima*) 1.5 per cent, chickweed (*Arenaria media*) 1.03 per cent; chickweed (*Arenaria rubra*) 1.92 per cent; plantain (*Plantago media*) 0.63 per cent, corydalis (*Corydalis bulbosa*) 3.88 per cent; heather (*Erica vulgaris*) 2.3 per cent; "Weigmann" 0.51 to 0.84 per cent, morel (*Morchella esculenta*) 1.32 per cent; "Birkenschwamm" 3.73 per cent; edible mushroom (*Chlorangium jussuffii*) 11.9 per cent; turf-moss (*sphagnum*) 3.0 to 8.0 per cent, *Lycopodium clavatum* 26.65 and *Lycopodium chamaecyparissus* 51.85 per cent alumina.

Other Cryptogams contain alumina, notably Gyrophora, Cladonia, Usnea, and Cetrarid.

Gobley (Jour. Pharm., 3d ser., 37, p. 19; Jour. Chim. Med., 4th ser., 6, p. 129; Rev. Chim. Appliquée, 2, p. 6; Vierteljahressch. Prakt. Pharm., 9, p. 567; Chem. Centbl., 1860, p. 587;

Chem. News, 2, p. 119; Jahresb. Chem., 1860, p. 550) notes the occurrence of alumina in the root of Kava root (*Piper methysticum*).

Godeffroy, R. (Arch. Pharm., 3d ser., 10 (1877), p. 297; Jahresb. Agr. Chem., 1877, p. 118), reports a trace of Al_2O_3 in the ash of cockle-burr (*Xanthium spinosum*).

Griffiths, A. B. (Compt. Rend. Acad. Sci. Paris, 131 (1900), p. 422), reports the percentage composition of a number of medicinal plants. Several contained alumina as follows: Sarsaparilla, 0.1 per cent; Cardamon, 0.1 per cent; "Chine," 0.13 per cent, and Rhatany, 0.1 per cent.

Guerrieri, F. (Staz. Sper. Agr. Ital., 34 (1901), p. 338), in an article on the value of grapevine branches as a feed for farm animals, reports a total of 2.9053 per cent ash. Of this 0.0650 was found to be aluminium sesquioxid. The proportions in hay are given as total ash, 8.0259, aluminium sesquioxid, 0.2340; in straw, total ash, 6.0584, aluminium sesquioxid, 0.2778 per cent.

Hadelich, W. (Chem. Centbl., 1881, p. 394; Jour. Chem. Soc. London, 42 (1882), p. 121), found in white wine from Erfurt 0.281 per cent ash which contained a trace of Al_2O_3.

Harms, E. (Arch. Pharm., 2d ser., 88 (1856), p. 165; Chem. Centbl., 1856, p. 944; Jahresb. Chem., 1856, p. 690), notes 6.05 per cent ash in air-dry Kousso (*Brayera anthelmintica*) containing 1.97 per cent Al_2O_3.

Harms, E. (Arch. Pharm., 2d ser., 1858, p. 137; Chem. Centbl., 1858, p. 443; Jahresb. Agr. Chem., 1858–59, pp. 64, 65), reports the following:

ALUMINIUM IN CERTAIN PLANTS.

Kind of Plant.	Water.	Ash in Fresh Material.	Aluminium Phosphate in Ash.
	Per Cent.	Per Cent.	Per Cent.
Chickweed (*Arenaria media*) whole plant in bloom	83.48	4.60	2.01
Plantain (*Plantago maritima*) green portion	79.52	3.91	1.13
Plantain (*Plantago maritima*) seed	.....	5.04	0.69
Chickweed (*Arenaria rubra*) entire plant	73.85	2.56	4.05

The ash was said to be not quite free from the soil on which the plants were grown. The aluminium content, therefore, is regarded as too large.

Harper, H. W. (Amer. Jour. Pharm., 53 (1881), p. 209), in a study of fragrant sumach (*Rhus aromatica*), identified aluminium as one of the constituents of the ash of the bark. The total ash was 13.85 per cent.

Hébert, A. (Bul. Soc. Chim., 3d ser., 13, p. 927; Jour. Chem. Soc. London, 70 (1896), II, p. 494), notes the occurrence of alumina in the sap of the banana tree, *Musa paradisica*.

Heller, C. F. (Amer. Jour. Pharm., 59 (1887), p. 68), reports 5.5 per cent ash in Bryony root, containing 7.5 per cent moisture. The ash was found to contain aluminium in addition to other mineral constituents, amount not stated.

Herapath, T. J. (Jour. Roy. Agr. Soc. England, 11, pt. 1, p. 93; Quart. Jour. Chem. Soc., 3, p. 193; Ann. Chem. Pharm., 76, p. 383; Jahresb. Chem., 1850, p. 647, 666, 671, Tab. A, B and D, p. 661), notes the occurrence of a trace of alumina in the ash of wheat, the total ash in dry material being 2.30 per cent, and 0.07 per cent alumina in the ash of oats, the total ash in the dry material being 3.06 per cent. He also reports a trace of alumina in the ash of horse bean (*Vicia faba*) seed, total ash, 4.3 per cent of dry material and traces in ash of eddoes or taro (*Arum* (Colocasia) *esculentum*) and yams (sweet potato) (*Convolvulus batatas*) containing respectively 1.647 per cent ash and 1.51 per cent ash in the fresh materials.

Hermann, J. C. (Viertel. Prakt. Pharm., 18, p. 481; Jahresb. Chem. Will., 1869, p. 796), notes 0.5851 per cent alumina in the ash of ergot (*Secale cornutum*); the amount of total ash is not stated.

Herrmann, J. C. (Viertel. Prakt. Pharm., 1869, p. 481; Amer. Jour. Pharm., 42 (1870), p. 143), reports 2.201 per cent ash in ergot. Aluminium phosphate is noted as a constituent of the ash.

Hertwig (Chevallier et Baudrimont's Dictionnaire des alterations, Paris, 1878, p. 1132) notes the occurrence of 9.04 per cent calcium, magnesium, iron, manganese phosphates and aluminium phosphates in Havana tobacco and 17.95 per cent of calcium, magnesium, iron, manganese, and aluminium phosphates in the ash of Hanover tobacco.

Herzberg, W. (Dingler's Polytech. Jour., 277, p. 478 (Ausz); Jour. Soc. Chem. Ind., 9, p. 758 (Ausz); Chem. Centbl., 1890, II, p. 186; Jahresb. Chem., 1890, p. 2877), reports 17.47 per cent ash in the fibers of the baobab tree (*Andansonia digitata*) used for paper making. Of this 0.14 per cent was alumina.

Hoeven, J. (Amer. Jour. Pharm., 55 (1888), p. 253), in a study of cheken leaves, reports 9.48 per cent ash. The portion insoluble in H_2O, but soluble in HCl, amounted to 5.61 per cent. This contained aluminium; amount not stated.

Höhn, H. (Arch. Pharm., 2d ser., 139 (1869), p. 213; Jahresb. Chem. Will., 1869, p. 771), reports 3.24 per cent ash in the stem and 6.61 in the leaf of *Ophelia chirata;* of this 1.47 and 4.35 per cent was Al_2O_3.

Hollandt, H. (Vierteljahressch. Prakt. Pharm., 10, p. 321; Jahresber. Agr. Chem., 1861–62, p. 60), reports 1.2035 per cent Al_2O_3 in the ash of the bark of *Millingtonia hortensis.*

Hooper, D. (Pharm. Jour. and Trans., 1887, Jan. 8; Amer. Jour. Pharm., 59 (1887), p. 86), reports a study of the ash of cinchona bark. As shown by the average of three hundred determinations, such bark (from India), contained 3.42 per cent ash. The ash of *C. officinalia* and *C. succirubra* grown on the Nilgiris contained respectively 2.70 and 4.24 per cent Al_2O_3.

Huber, L. (Arch. Pharm., 3d ser. 7 (1875), p. 394; Jahresb. Agr. Chem., 1875–76, p. 136), reports 0.250 per cent Al_2O_3 in the ash of the rind of the root of elder (*Sambucus nigra*), the ash being equal to 11.717 per cent.

Irby, J. R. McD., and **J. A. Cabell** (Chemical News, 1874, p. 117, Centbl. Agr. Chem., 6 (1874), p. 366) note the presence of some Al_2O_3 with the Fe_2O_3 in six sorts of Virginia tobacco.

Jackson, D. D. (Jour. Soc. Chem. Ind., 21 (1902), p. 681), reports the results of a study of the precipitation of iron, manganese and aluminium from natural waters by the action of bacteria, viz., *Crenothrix kühniana*, *C. manganifera*, and *C. ochracea*, respectively. Dr. Jackson states that each of the three species seems to exercise a selective power in precipitating the special oxid ascribed to it, and that about one-third of the dry organism is composed of the oxid selected, whether iron, manganese, or aluminium. He reports analyses of the precipitate due to the three species in three different waters:

PRECIPITATE CAUSED BY CRENOTHRIX SP. FROM DIFFERENT WATERS.

	Fe_2O_3.	Mn_2O_3.	Al_2O_3.	SiO_2.	Aluminium Silicate.	Undeterminable Mineral Matter.	Organic Matter.
	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.
Crenothrix kühniana from filter gallery, Ipswich River, Mass.	31.6	. . . .	5.7	11.1	10.4	4.2	37.0
Crenothrix manganifera, filter gallery, Charles River, Newton, Mass.	14.4	33.9	1.5	12.5	8.0	1.8	27.9
Crenothrix ochracea, driven wells at Oconee, Brooklyn, New York.	14.7	. . . .	33.3	5.9	7.6	2.3	36.2

The waters in which the crenothrix species grew were analyzed. They contained alumina (parts per million) as follows: Water from filter gallery, shore Ipswich River, Reading, Massachusetts, 0.6; water from filter gallery, shore Charles River, Newton, Massachusetts, 0.5, and water from driven wells, Oconee, Brooklyn, N. Y., 2.0.

Jessler, A. (Vierteljahressch. Prakt. Pharm., 17, p. 266, Jahresber. Chem. Will., 1868, p. 807), reports 13.18 per cent ash in the rhizome of dog-bane (*Cynanchum monspeliacum*). This is reported to contain alumina; the amount is not stated.

Hassall, J. (Food Adulteration, p. 617), reports 4.80 per cent ash in anatto. This contained 0.20 per cent alumina (with a trace of iron).

Kane (Phil. Mag., 3d ser., 31, pp. 36, 105; Jour. Prakt. Chim., 41, p. 434; 32, p. 354; Jahresb. Chem., 1847–48, p. 1085) reports total ash as follows in flax stems (treated in different ways) from Ireland, Holland, Belgium, etc., 4.237, 5.434, 3.670, 5.151, and 5.000 per cent. Of this 0.44, 0.44, 0.72, 1.44, and 6.08 per cent respectively was alumina.

Karmrodt, C. (Ztschr. Landw. Ver. Rheinpreussen, 1864, p. 427; Jahresb. Agr. Chem., 1864, p. 98), determined the constituents of the ash of a number of Coniferæ. Larch needles (*Pinus larix*) contained 0.264 per cent; Scotch pine needles

(*P. sylvestris*) 0.125 per cent, and fir needles (*Abies excelsa*) 1.427 per cent Al_2O_3.

Kayser, R. (Repert. Analyt. Chem., 1883, p. 289; Jahresb. Agr. Chem., 1883, p. 349), in an article on fruit and fruit juices, reports traces of Al_2O_3 in the juice of red and white currants (containing respectively 0.38 and 0.5 per cent ash) and of strawberries.

Kayser, R. (Repert. Analyt. Chem., 1883, p. 182; Jahresb. Chem., 1883, p. 1407), analyzed dry blueberries, reporting in them 0.005 per cent alumina.

Kayser (Repert. Analyt. Chem., 1882, p. 242) finds that the presence of 0.3–0.4 grain of alumina per liter in wine cannot safely be taken as a proof that alum has been added because it takes into solution during its course of manufacture some alumina. This is especially the case when the wine has been cleared with kaolin (silicate of alumina), as some wines dissolve small amounts of the kaolin, and hence contain alumina in the form of a soluble salt.

Kebler, L. F. (Amer. Jour. Pharm., 67 (1895), p. 398), in a study of the determination of morphine in opium, reports that the ash of crude morphine (percentage amount not given) contained 0.43 per cent aluminium phosphate.

Keim, W. (Ztschr. Analyt. Chem., 30 (1891), p. 401), reports the following amounts of pure ash in cherry (*Prunus cerasus*) fruit at different times:

May 21, 0.516 per cent; May 28, 0.646 per cent; June 19 (ripe), 0.739 per cent. Of these, 2.55, 0.80, and 0.81 per cent respectively was Al_2O_3.

Khittel (Vierteljahressch. Prakt. Pharm., 7, p. 348; Jahresb. Chem., 1858, p. 530) found 7.91 per cent ash in leaves of poison-ivy (*Rhus toxicodendron*) (dried at 100°). Of this 0.49 per cent was Al_2O_3.

Knop (Kreislauf des Stoffes, 1868, p. 263) states that the roots of the Lycopodiæ secrete besides carbonic acid strong organic acids, which dissolve the alumina of soils, and this solution enters the root. The lichens also contain in their structures peculiar crystallizable acids which, by the action of reagents, break up into oxalic acid and a new organic acid. The oxalic acid thus formed dissolves the alumina and iron oxid, and thus the mosses corrode the surfaces on which they grow, the hard rock as well as the dust that clings to it. In this way the dissolved alumina passes into the interior of the moss. It would seem a principle that plants secreting strong organic acids, which act on surrounding material, will contain alumina and show it in their ash.

Knop, W. (Landw. Vers. Stat., 7 (1865), pp. 436–450), reports 31.01 per cent ash (including 15.00 per cent sand) in *Chlorangium jussuffii;* this included 1.90 per cent Al_2O_3.

Other ash analyses of lichens which he reports are quoted in part as follows:

ALUMINA IN CERTAIN LICHENS.

Kind of Lichen.	Pure Ash in Dry Matter.	Al_2O_3.
	Per Cent.	Per Cent.
Gyrophora pustulata..........................	1.666	0.344
Ramalina fraxinea, from quartz porphyry........	2.346	0.031

Kresling, K. (Arch. Pharm., 3d ser., 229 (1891), p. 389; Jour. Chem. Soc. London, 62 (1892), II, p. 232), in the pollen of Scotch pine (*Pinus sylvestris*), reports 5.51 per cent crude ash, equivalent to 3.0 pure ash. This contained 1.86 per cent Al_2O_3.

Krutzsch, H. (Tharander forstl. Jahrb., 6 (1850), p. 88), as cited by Wolff (Aschen Analysen, Berlin, 1880, pt. 2, pp. 87, 130), determined the ash constituents of freshly fallen fir needles, and of dry twigs, dry bark, dry cones, and moss, found in the litter. The pure ash in the several materials was equal to 1.601, 1.043, 1.275, 0.477, and 2.884 per cent respectively. Of the pure ash 4.20, 8.33, 7.86, 9.20, and 20.5 per cent respectively was Al_2O_3. The Al_2O_3 is regarded as due to earth present in the material. Wolff states that on an average (based on fourteen analyses) fir-needle litter contains 1.410 per cent pure ash; from 0 to 9.98 per cent or on an average 3.58 per cent of this being Al_2O_3. In this and all the other analyses cited from Wolff the complete ash analyses are given.

Langer, A. (Ueber Bestandtheile der Lycopodiumsporen. Inaug. Diss. Erlangen, 1889; Just's Bot. Jahresb., 1889, I, p. 39), reports an analysis of the spores of a club moss (*Lycopodium clavatum*). These contained on an average 1.155 per cent of mineral matter with 24.41 per cent of $Al_2(PO_4)_2$.

Langer, A. (Arch. Pharm., 3d ser., 27 (1889), p. 289; Jahresb. Agr. Chem., 1889, p. 383), reports 1.15 per cent ash in commercial lycopodium powder (*L. clavatum*) which was 96.67 per cent pure. Of this 15.30 per cent was Al_2O_3.

LaWall, C. H. (Amer. Jour. Pharm., 69 (1897), p. 137), in a study of the ash of various drugs, reports aluminium as a constituent of aconitum root, belladonna leaves, calumba roots, castanea leaves, chimaphila leaves, cinchona, calisaya bark, digitalis leaves, frangula bark, gelsemium root, geranium rhizome, glycyrrhiza root, guarana seed (crushed), hops, hydrangea root, hydrastis rhizome, hyoscyamus leaves, jalap tuberous root, kola-nut, *Piscidia erythrina* bark, choke-cherry (*Prunus virginiana*) bark, cascara (*Rhamnus purshiana*) bark, ruta herba, sabadilla seed, bloodroot (*Sanguinaria*) rhizome, dandelion (*Taraxicum*) root, red clover (*Trifolium pratense*) flowering tops, elm (*Ulmus*) bark, hellebore (*Veratrum viride*) rhizome rootlets, and prickly ash (*Xanthoxylum*) bark. The amount of this and other constituents was not determined. The total ash was generally determined.

Lermer, J. (Dingler's Polytech. Jour., 179, p. 71; Bul. Soc. Chim., 2d ser., 6, p. 429; Jahresb. Chem. Will., 1866, p. 882), reports 6.91 per cent ash in Hungarian malt (barley) sprouts and 6.19 per cent in German. The ash contained respectively 1.06 and 0.45 Al_2O_3.

Lermer (Wittstein Viertel. Jahressch., 13, p. 182; Jahresb. Agr. Chem., 1865, p. 117) reports 7.135 per cent ash in air-dry hops; 0.763 per cent of this was found to be Al_2O_3.

Lewitsky, J. (Arbeiten der dritten Versammlung russischer Naturforscher zu Kiew.—Vereinigte Sectionen der Botanik und Chemie; Just's Bot. Jahresber., 2 (1874), II, p. 866), reported a series of studies of the relation of the phosphates of iron, calcium, and aluminium to plant growth. Investigations have shown that the addition of calcium phosphate to the soil results in the formation of ferric phosphate and aluminium phosphate, so that after a time, even under the most favorable conditions, practically only a trace of calcium phosphate remains. On the basis of this conclusion, the author believes that under normal conditions the roots of plants have access only to iron phosphate and aluminium phosphate and must derive their phosphates from these salts. To test the theory, culture experiments were made with barley by Hellriegel's method (Ann. Landw., 38, p. 296). Briefly stated, the grain was sown in quartz sand to which nutrient solutions were added. These were made up of KNO_3 (or under certain conditions, $Ca(NO_3)_2$), $CaCO_3$, NaCl, $MgSO_4$, and Fe_2O_3, in what were deemed the proper proportions. With such a basal mixture, $Fe_2(PO_4)_2$, $Ca_3(PO_4)_2$, and PO_4KH_2 were added in the first test of the experiments, while in a control experiment, which is described in less detail, $Al_2(PO_4)_2$ was also used. The plants were watered with water containing CO_2. Their growth and seed production is described in detail. In the principal test, the best growth was made by the barley grown with a nutrient mixture containing $Fe_2(PO_4)_2$. The next best results were obtained with KH_2PO_4; the least satisfactory, with $Ca_3(PO_4)_2$. The remaining test was not regarded as entirely satisfactory and gave results somewhat at variance with those already obtained; but in general it showed, according to the author, that $Al_2(PO_4)_2$ had practically the same effect as a corresponding iron salt and that the corresponding calcium salt was not as satisfactory for the plants as the iron salt.

L'Hote (Compt. Rend. Acad. Sci. Paris, 104 (1887), p. 853), reported an investigation dealing with the detection and estimation of alumina in wine and grapes. Wines from seven localities were found to contain alumina per liter as follows:

From Bourgogne, 0.02 gm.; Cher, 0.036 gm.; Touraine, 0.000 gm.; Roussillon, 0.032 gm.; Spain, 0.016 gm.; Sicily, 0.012 gm.; and from Aude, 0.016 gm.

When prepared in the laboratory, wine from grapes from Huesca contained per liter 0.012 gm.

From 479 gms. of red grapes 0.013 gm. alumina was obtained, while the stalks weighed 6.482 gms. and contained 0.003 gm. alumina.

Light, W. W. (Amer. Jour. Pharm., 56 (1884), p. 3), reports the analysis of the fruit of prickly pear (*Opuntia vulgaris*). The ripe fruit contained 68.2 per cent moisture and 1.76 per cent ash, and contained phosphate of aluminium.

Lindenmeyer, G. (Vierteljahressch. Prak. Pharm., 17, p. 290; Jahrb. Chem. Will., 1868, p. 814), reports 3.5878 per cent ash in China bark (*Cinchona*) from Puerto Cabello, containing 0.488 per cent alumina.

Huschke, O. (Vierteljahressch. Prak. Pharm., 17, p. 284; Jahresb. Chem. Will., 1868, p. 814), reports 1.21 per cent ash in orange peel. This contained 0.069 per cent alumina.

Loew, O. (The Physiological Rôle of Mineral Nutrients: U. S. Dept. Agr., Division of Vegetable Physiology and Pathology Bul. 18 (1899), p. 9). The possibility of the occurrence of aluminium salts in plants is frequently spoken of by botanical writers. Thus the author cited says regarding mineral compounds found in living organisms: "Occasionally there are present in plants small quantities of titanic and boracic acids, lithia, and alumina, and of the oxids of lead, zinc, and copper."

Luca, S. de (Compt. Rend. Acad. Sci. Paris, 51 (1860), p. 176), reported 6 per cent ash in Spanish moss (*Tillandsia dianthoidea*), an aerial parasite. This contained a trace of Al_2O_3.

Ludwig, H. (Arch. Pharm., 2d ser., 52 (1847), p. 61; Pharm. Centbl., 1848, p. 669; Jahresb. Chem., 1847–48, p. 1095), found 2.36 per cent ash in so-called "Caraccas" Sarsaparilla root, purchased in Honduras. Of this 5.11 per cent was alumina.

Ludwig, H. (Arch. Pharm., 3d ser., 1 (1872), p. 482; Jour. Chem. Soc. London, 26 (1873), p. 525), notes Al_2O_3 in the ash of different parts of the coffee tree as follows: Root of young tree in bearing, 7.85; root of old tree, 1.59; leaves, 9.11; pulp of pericup, trace; parchment-like coating of coffee bean, 4.19; coffee beans grown in gneiss soil, 2.78 per cent, and coffee beans grown on limestone soil, a trace.

MacDonald, J. W. (Chem. News, 37, p. 127; Jour. Chem. Soc. London, 1878, II, p. 624), examined the ash of cane and beet sugar accumulated from the analyses made in a year in a large sugar refinery, reporting among other constituents, 6.90 per cent ferric oxid and alumina in cane-sugar ash and 0.28 per cent in beet-sugar ash.

Maiden, J. H., and **H. G. Smith** (Jour. and Proc. Roy. Soc. New South Wales, 29 (1895), p. 325) report, in a silky oak log (*Grevillea robusta*), a large amount of a white substance having the appearance of whiting. Some six ounces were secured, but it is stated that a large proportion of the substance must have been lost and that there is no means of knowing the total quantity originally present in the cavity in the log. Analysis showed this material to consist of basic aluminium succinate. The authors regard it probable that the aluminium was originally present in the sap of the tree as a malate. No inorganic acid was detected in the sample analyzed.

Malaguti, F. J., and **J. Durocher** (Ann. Chim. et Phys., 3d ser., 54 (1858), p. 257, tables 1 to 4) report detailed studies of the ash of one hundred and fifteen wild plants of different families growing on a variety of soils in France. The oxids of iron, aluminium, and manganese are reported together. This work is of especial interest historically.

Mariani, G. (Studi chimico-agrari sugli equiseti, Studi e ricerche istituite nel R. Laboratorio di Chim. Agrar. di Pisa, 7 (1888), p. 69; Staz. Sper. Agrar. Ital., 14 (1888), p. 355; Just's Bot. Jahresber., 1888, pt. 1, p. 58), reports an analysis of a horse tail (*Equisetum telmateja*) grown in Pisa. This had a water content of 78.033 per cent. The CO_2 free ash (amount not given) contained 0.963 per cent Al_2O_3.

Matusow, H. (Amer. Jour. Pharm., 69 (1897), p. 341), reports aluminium as one of the constituents of the ash of broad-leaved laurel (*Kalmia latifolia*) root; amount not stated. The total ash was 1.24 per cent.

Mayer, A., (Lehrbuch der Agricultur Chemie 3d Ed., 1886, p. 280) states that aluminium is found in a seriesof plants as a regular constituent, and frequently in not subordinate amounts. In *Lycopodium complanatum* acetate of aluminium occurs in such quantities that a lye made from the plant can be used directly in dyeing as a mordant. This same salt has been found in wine grapes; and it is an assured fact that various parts of the grapevine on incineration leave in the residuum aluminium compounds. Vauquelin states that he found acetate of aluminium in the sap of the birch, which at best must be considered as an anomaly.

Minas, M. (Zur Frage über den Einfluss pasteurisierten Traubensaftes auf den allgemeinen Stickstoffumsatz, das Körpergewicht und die Darmfäulniss beim gesunden Menschen bei gemischter Kost. Inaug. Diss. Dorpat, 1900; Ztschr. Untersuch. Nahr. u. Genussmtl., 4 (1901), p. 204), analyzed a pasteurized grape juice (prepared by a Russian firm for medicinal use) and found that it contained 0.004 per cent of Al_2O_3.

Mitscherlich (Berlin. Acad. Ber., 1847, Nov., p. 430; Jour. Prak. Chem., 43, p. 158; Pharm. Centbl., 1848, p. 337; Inst., 1848, p. 186; Jahresb. Chem., 1847–48, p. 832) found in one of the marine Algæ (*Conferva glomerata*) (dried at 130°), 12.27 per cent ash; of this 0.42 per cent was alumina.

Moritz, J. (Ann. Oenologie. 4, p. 153; Just's Bot. Jahresber., 1874, II, p. 855), studied the draft on soil made by grapes of the variety "Sylvaner." The fresh wood contained 50 per cent more ash than the fresh fruit. He calculated that the grape plants withdrew 35.343 pounds mineral matter per morgen (0.63 acre) from the soil; of this 0.05 pound was Al_2O_3.

Muck (Vierteljahressch. Prak. Pharm., 5, p. 544; Chem Centbl., 1856, p. 848; Jahresb. Chem., 1856, p. 690) notes 12.5 per cent ash in the leaves of belladonna (*Atropa belladonna*) (dried at 100°) containing 0.01 per cent Al_2O_3.

Munroe, W. R. (Amer. Jour. Pharm., 70 (1898), p. 489), in an analysis of the rhizome of an aralia (*Aralia californica*), reports 2.22 per cent ash in which aluminium was present in the form of phosphate.

Nettlefold, P. (Chem. News, 55, p. 191; Jahresb. Chem., 1887, p. 2304), reports 0.571 per cent ash in an edible fungus (*Bovista gigantaea*). Of this 15.66 per cent was alumina.

Parodi, D. (Pharm. Jour. Trans., 3d ser., 10, p. 667; Jour. Chem. Soc. London, 37 (1880), p. 721), in a cucurbitaceous plant, tayuya (*Trianosperma ficifolia*), found 1.23 per cent iron and aluminium.

Payen (Compt. Rend. Acad. Sci. Paris, 28, p. 613; Pharm. Centbl., 1849, p. 516; Jahresb. Chem., 1849, p. 481) notes 0.12 per cent insoluble, and 0.16 per cent soluble ash in sugar cane. One of the ash constituents was alumina.

Peckolt, T. (Pharm. Jour. Trans., 3d ser., 10, pp. 343, 383; Ztschr. Oesterr. Apoth. Verein, 1879, pp. 361, 373; Jahresb.

Chem., 1879, p. 931), in a study of the fruit of paw-paw (*Carica papaya*), states that the dry flesh of the fruit of one variety, *Mamao femea*, contained 8.457 per cent ash. Of this 3.857 per cent was alumina.

Peckolt, T. (Wiener. Akad. Ber. 54 (2. Abt.) p. 462; Jahresb. Chem. Will., 1866, p. 708), reports 10.19 per cent ash in shells of seeds of Guarana (*Paulina sorbilis*); 1.704 per cent in seeds without shells and 2.6 per cent in Guarana paste; the last two contained respectively 1.06 and 0.82 per cent Al_2O_3.

Penney, M. D. (Chem. News, 39, p. 80; Jour. Chem. Soc. London, 36 (1879), II, p. 556), studied the occurrence of alumina in flour and wheat, finding, he states, larger quantities than are generally supposed to be present. Part of this he attributes to careless packing of the wheat. The Egyptian wheat noted below was largely contaminated with clay owing to the manner of packing in Nile boats.

In six samples of flour, he found alumina as follows, the amount representing grains in four pounds: No. 1, 24.30; No. 2, 21.75; No. 3, 21.25; No. 4, 17.00; No. 5, 12.40, and No. 6, 6.34.

The aluminium phosphate (milligrams per 100 grams) found in twenty-two samples of wheat was as follows: No. 1, Calcutta, 24.30; No. 2, Calcutta, 21.00; No. 3, Calcutta, 18.50; No. 4, Kourish, 27.20; No. 5, Kourish, 31.00; No. 6, Russian, 17.20; No. 7, Russian, 24.45; No. 8, Russian, 13.10; No. 9, Russian, 16.35; No. 10, Chicago, 4.00; No. 11, Oregon, 4.00; No. 12, English, 5.12; No. 13, English, 6.40; No. 14, English, 7.30; No. 15, English, 3.80; No. 16, Stein, 16.33; No. 17, Stein, 13.24; No. 18, California, 3.00; No. 19, Mixed (eleven varieties), 15.10; No. 20, Egyptian, as imported, 167.00; No. 21, Egyptian, hand-picked, 49.49; No. 22, Egyptian, washed, 14.10.

Percival, J. (Agricultural Botany, New York, 1900, p. 167), notes the occasional presence of alumina in small amounts in certain plants. In sea-weeds bromine and iodine, he states, are present, and many other elements such as aluminium, zinc, and copper have been occasionally discovered in small quantities in certain species of plants.

Petter, K. (Vierteljahressch. Prak. Pharm., 11, p. 545; Jahresb. Chem., 1862, p. 511), found 23.15 per cent ash in one of the common Algæ (*Cladophora glomerata*) (dried at 110°). Of this 0.225 per cent was Al_2O_3.

Pfeffer, W. (Pflanzen-Physiologie, 2d ed., 1897, Vol. I, p. 432), in discussing the nutrients of plants, makes in effect the following statement: Aluminium, although it is so generally distributed, occurs in the ash of most plants only in small amounts. In the case of *Lycopodium chamaecyparissus* and *alpinum*, it constitutes 22 to 27 per cent of the ash. It is also abundantly present in *Chlorangium jussuffii* according to Wolff (Aschen Analysen, 1871, pp. 134, 136), while Church found only traces of it in *Lycopodium phlegmaria*, in *Selaginella*, etc. Whether or not aluminium occurs in *Lycopodium*, as Arosenius states in the form of tartrate, is not definitely known.

Pizzi, A. (Staz. Sper. Agr. Ital., 16 (1888), p. 737; 17 (1889), p. 1; Centbl. Agr. Chem., 19 (1890), p. 353; Jahresb. Agr. Chem., 1890, pp. 287, 288), reports 1.80 per cent ash in white truffle (*Tuber magnatum*) from the Apennines, of which 6.9 per cent was Al_2O_3. In black truffle (*T. melanosporum*), from the same region, he found 2.09 per cent ash of which 5.3 per cent was Al_2O_3.

Pizzi, A. (Staz. Sper. Agr. Ital., 17, p. 167; Jahresb. Chem., 1889, p. 2109), reports 1.342 per cent ash in the morel (*Morchella esculenta*). Of this 3.120 per cent was Al_2O_3.

Ramdohr (Arch. Pharm., 2d ser., 91 (1857), p. 129; Ztschr. Pharm., 1857, p. 70; Chem. Centbl., 1857, p. 705; Jahresb. Chem., 1857, p. 515) notes 3.62 per cent ash in air-dry ergot (*Secale cornutum*) from cheat or chess (*Bromus secalinus*) and 2.91 per cent in ergot from rye (*Secale cereale*). These contained respectively 1.09 and 0.33 per cent Al_2O_3.

Reichardt, E. (Arch. Pharm., 2d ser., 73 (1853), p. 257; Pharm. Centbl., 1853, p. 267; Jahresb. Chem., 1853, p. 581), examined the leaves, bark, and wood of willow (*Salix vitellina*) in autumn and spring, reporting (per 1000 parts fresh material) 0.05 Al_2O_3 in autumn leaves, and 0.03 in autumn bark and wood, 0.03 in spring leaves, and 0.06 in spring bark and wood. He found also (Arch. Pharm., 2d ser., 75 (1853), p. 19; Pharm. Centbl., 1853, p. 566; Jahresb. Chem., 1853, p. 584) 0.39 and 0.46 $Al_2O_3.PO_5$ per 1000 parts dry matter in thick (old) and thin (young) bark, from a willow, about five years old, gathered near the end of October, 1852.

Reichardt, E. (Chem. Bestandtheile der Chinarinden, Braunschweig, 1855; Pharm. Centbl., 1855, p. 631; Ztschr. Pharm., 1856, p. 25; Jahresb. Chem., 1855, p. 720), reports ash in the following drugs: *China flava fibrosa* (this and all the others dried at 100°) 1.6338 per cent; *C. rubra*, 1.6607 per cent; *C. huanuco*, 2.5134 per cent; *C. regia sine epid.*, 1.2236 per cent; *C. regia cum epid.*, 1.6449 per cent. He reports aluminium phosphate in these as follows: 0.0473, 0.0528, 0.0467, 0.0465, and 0.0403, or re-calculated and expressed in percentage of total ash (according to abstracts for Jahresb. Chem.) 1.203, 1.324, 0.771, 1.580, and 1.017 per cent alumina.

Reithner (Vierteljahressch. Prakt. Pharm., 4, p. 382; Jahresb. Chem., 1855, p. 723) notes 4.3 per cent ash in the leaves of holly (*Ilex aquifolium*) dried at 100°. Of this 0.66 per cent was Al_2O_3.

Reithner (Vierteljahressch. Prakt. Pharm., 4, p. 481; Pharm. Chem., 1855, p. 834; Jahresb. Chem., 1855, p. 724) notes 4.05 per cent ash in the dry flowers, without anthers, of colchicum or autumn crocus (*Colchicum autumnale*) and 4.15 per cent in the dry anthers. The ash contained respectively 0.27 per cent and a trace of Al_2O_3.

Ricciardi, L. (Gaz. Chim. Ital., 19 (1889), p. 150), studied the aluminium content of the ash of different portions of several plants. He found that the ash of grape-vines grown on clay soil contained 0.85 per cent alumina; on soil containing an abundance of lime, 0.81 per cent; and on soil with a medium lime content, 1.14 per cent. He also found 0.218 per cent alumina present in the ash of the branches and twigs, 0.093 in the skins and seeds, and 0.022 in the leaves of the mandarin orange. The ash of Indian fig fruit, "prickly pear" from Bari, contained 0.063 per cent; from Catania, 0.092. The ash of the rind of the prickly-pear fruit from Bari contained 0.148 per cent; from Catania, 0.167. The ash from the flesh of St. John's breadfruit (*Ceratonia siliqua*) from Bari contained 0.503 per cent; from Catania, 0.607; the ash of the seeds from Bari, 0.062; from Catania, 0.064. The ash of almond shells grown near Bari contained 0.695 per cent Al_2O_3, the ash of the kernels

0.138. The ash of tobacco leaves contained 2.151 per cent alumina. The seeds and skin of mandarin oranges grown near Cara contained in the ash 0.121 per cent Al_2O_3, and white lupine ash 0.042 per cent Al_2O_3. Further, wine was found to contain 0.022 gm. Al_2O_3 per liter. The author concludes that the assimilation of alumina does not depend on the percentage in the soil, and that, generally speaking, alumina is most abundant in the trunk and branches, less so in the husks and seeds, and least of all in the leaves.

Ringer, F. A., and **E. Brooke** (Amer. Jour. Pharm., 64 (1892), p. 255) report 4.29 and 1.32 per cent ash in roots of true and commercial pareira respectively. Both contained Al_2O_3; the amount not stated.

Ritthausen, H. (Jour. Prakt. Chem., 53 (1851), p. 413) reports 36.250 per cent Al_2O_3 in the pure ash of a club-moss (*Lycopodium complanatum*).

Ritthausen, H. (Jour. Prakt. Pharm., 58, p. 133; Pharm. Centbl., 1853, p. 531; Jahresb. Chem., 1853, p. 586) reports 39.07 and 20.69 per cent Al_2O_3 in ash of club-mosses (*Lycopodium chamaecyparissus* and *L. clavatum*). The amount of total ash was not stated.

Rode, C. (Vierteljahres. Prakt. Pharm., 9, p. 530; Jahresb. Agr. Chem., 1861–62, p. 61), reports 0.15 per cent Al_2O_3 in the ash of the leaves of cuckoo-pint (*Arum maculatum*). The leaves contained a total of 88 per cent water; the water-free material, 10.12 per cent ash.

Rotondi, E. (Rel. lav. esequiti. lab. Chim. R. Staz. enol. Asti, 1878, p. 111; Centbl. Agr. Chem., 8 (1879), p. 530), studied the ash constituents of grape must, branches, and leaves from two vineyards near Asti. In every case the vine and leaves were selected after the grape harvest from vines which had borne fruit. The branches of Pinot grapes from Galletria d'Asti contained 2.91 per cent pure ash in dry matter, of which 0.13 per cent was Al_2O_3. Branches of Barbara grapes from Costigliole d'Asti contained 3.37 per cent pure ash in dry matter; of this 0.02 per cent was Al_2O_3. Traces of alumina are also reported in branches and leaves of Barbara and Grignolino grapes from Galleria d'Asti and in must of Barbara and must and branches from Fresia grapes from Costigliole d'Asti.

Ruge, G. (Apoth. Ztg., 1891, p. 208; Jahresb. Agr. Chem., 1891, p. 244), states that floating buttercup (*Ranunculus fluitans*) contains 14.349 per cent ash in the dry matter; 0.33 per cent of this being Al_2O_3.

de Saussure, T. (Recherches Chimiques sur la Végétation, Paris, 1804) discusses the ash constituents of plants, and in tables at the end of the volume reports the ash constituents of a considerable number. From these tables the following is quoted: In the leaves and other portions of a large number of trees and plants the amount of aluminium in the ash was less than 0.01 per cent. The leaves of a rhododendron (*Rhododendron ferrugineum*) contained 3 per cent ash in the dry matter; of this 0.12 per cent was alumina. Another sample contained 2.5 per cent ash in the dry matter, 0.12 per cent of this also being alumina. The branches of the same plants contained 0.8 per cent dry matter; of this 0.12 per cent was alumina. Saussure's investigation is interesting chiefly from an historical standpoint.

Sayre, L. E. (Amer. Jour. Pharm., 69 (1897), p. 543), reports a study of the composition of dandelion (*Taraxacum*) root. A sample dried at 100° contained 11.13 per cent ash. Of this 18.07 per cent was Al_2O_3.

Schäzler, M. (Vierteljahressch. Prakt. Pharm., 11, p. 270; Jahresb. Chem., 1862, p. 514), found 5.12 per cent ash in the finest Ceylon cinnamon bark (dried at 110°). Of this 0.55 per cent was Al_2O_3.

Schlegel, C. E. (Amer. Jour. Pharm., 57 (1885), p. 426), reports the analysis of the fruit of star anise (*Illicium anisatum*). The seed capsules contained 10.36 per cent moisture and 3.5 per cent ash. This was made up, according to the author, of potassium, sodium, iron, aluminium, hydrochloric acid, and phosphoric acid.

Schreiner (Vierteljahressch. Prakt. Pharm., 5, p. 207; Jahresb. Chem., 1856, p. 691), reports 0.72 per cent ash in the fresh fruit of sloe or black thorn (*Prunus spinosa*). Of this 0.5 per cent was Al_2O_3.

Schriddl, P. (Arch. Pharm., 1873, p. 375; Centbl. Agr. Chem., 5 (1874), p. 50), reports the percentage of Al_2O_3 in the ash of four samples of tea leaves and two of wood as follows: 0.810, 1.015, 2.226, 2.072, 4.093, and 2.834. They were from Java and in the case of Nos. 3, 4, and 6 were affected with a tea disease.

Sestini, F. (Gaz. Chim. Ital., 4 (1874), p. 182; Jahresb. Chem., 1874, p. 906), notes a trace of alumina in the ash of a seaweed (*Posidonia oceanica*) which is used as a fertilizer.

Sestini, F. (Gaz. Chim. Ital., 15 (1885), p. 107; Landw. Vers. Stat., 32 (1886), p. 197; Jahresb. Chem., 1885, p. 1848), studied the relation between the atomic weight and the physiological functions of the elements. He says in effect regarding certain elements, "Many elements which are not yet regarded as necessary for plants are found in plant ash, as aluminium, lithium, and fluorine." He believes that no element with an atomic weight over 56 enters directly into the formation of living material.

Sestini, F. (Stud. e Ricer. Inst. Lab. Chim. Agr. Pisa, 6, p. 87; Chem. Centbl., 1887, p. 939; Jahresb. Chem., 1887, p. 2647), determined the aluminium content of a number of wines. He found per 1000 cc. in ordinary red wine, from Peccioli (1884), 0.017 gm.; in ordinary red wine from Ghezzano (1884), 0.034 gm.; in red wine from Calci (1884), 0.038 gm.; from Collesalvetti (1883), 0.006 gm.; from Collesalvetti (1884), 0.002 gm.; from S. Giuliano (1884), 0.005 gm.; and from S. Giuliano (1885), 0.009 gm. He concludes, therefore, that a natural wine does not contain more than 0.03 gm. alumina per liter and that alumina will never exceed 0.2 per cent of the pure ash.

Shepard, C. U. (Trans. N. Y. State Agr. Soc., 1844, p. 343), reports traces of alumina in the ash of rice straw. He also reports traces in the ash of corn (grains) as quoted by J. H. Salisbury (Trans. N. Y. State Agr. Soc., 1848, p. 726).

Smith, H. G., in an article entitled "Aluminium, the Chief Inorganic Element in a Proteaceous Tree, and the Occurrence of Aluminium Succinate in Trees of this Species" (Chem. News, 88 (1903), p. 135), reports the occurrence of a large deposit of basic aluminium succinate of the formula $Al_2(C_4H_4O_4)3Al_2O_3$ in the center of a silky oak tree 3 feet in diameter (*Orites excelsa*) from Queensland. The ash of the wood farthest from the deposit contained 79.61 per cent alumina. The large deposit was regarded as a natural effort to get rid of a surplus of alumina not needed by the tree.

Three other samples of the same kind of tree from northern New South Wales were examined and in the ash of all a large amount of alumina was found, the quantity ranging from 36 to 43 per cent. Much of the alumina in the ash was present as a potash salt soluble in water, and as no carbonate of potash was found "it is supposed that the potassium aluminate was originally present in the tree as such."

As no alumina was found in the ash of *Grevillea robusta*, *G. helliana*, and *G. striata*, the author believes that it is probable that the tree reported to contain it in an earlier article by J. H. Maiden and himself (see page 26) was *O. excelsa* and not *G. robusta*, as stated at the time.

Smith, A. Percy (Chem. News, 28, p. 261, 324; Jahresber. Chem., 1873, p. 851), reports (by difference) 1.459 per cent alumina and lithium carbonate in the ash of Havana tobacco.

Smith, Watson (Jour. Chem. Soc. London, 37 (1880), II, p. 416), analyzed the ash of two varieties of eucalyptus wood. *E. rostrata* contained 2.25 per cent ash and *E. globulus* 2.01 per cent. The former contained 0.78 per cent ferric and aluminic phosphate, the latter 1.07 per cent. In the latter a trace of Al_2O_3 was also noted.

Snyder, H. (Chemistry of Plant and Animal Life, 1903, Easton, Pa., p. 168), says: "Aluminium is found in the ash of many plants, as wheat, peas, beans, and rice, although it occurs in very small amounts and, so far as known, is not essential for plant growth. Most soils contain traces of soluble silicates of aluminium, and hence plants cannot well be free from it."

Solms-Laubach, Graf (Ann. Chem. u. Pharm., 100 (1856), p. 297), reports 2 per cent Al_2O_3 in the ash of a lycopod (*Lycopodium denticulatum*).

Speiss, E. (Wittstein's Vierteljahresschrift, 9, p. 392; Jahresber. Agr. Chem., 1860–61, p. 59), analyzed the ash of the bark of the root of the pomegranate and the root-stalks of male fern. The ash of the former contained a trace of Al_2O_3 and that of the latter 0.071 per cent.

Staffel, E. (Preisschrift. Arch. Pharm., 2d ser., 64, I, p. 129; Ann. Chem. Pharm., 76, p. 379; Pharm. Centbl., 1850, p. 897, 1851, p. 146; Jahresb. Chem., 1850, p. 661 and Table D, p. 661), in a study of the question whether the inorganic constituents of different organs of a green plant varied at different seasons, reports alumina in ash as follows: Horse-chestnut wood (autumn), 0.23 per cent; bark, 0.18 per cent; leaves (spring), 0.41 per cent; leaves (autumn), 0.51 per cent. The total ash in the above (dry material) was 3.38, 6.57, 7.69, and 7.52 per cent respectively. He also reports alumina in ash of English walnut bark (autumn), 0.29 per cent; leaves (spring), 0.18 per cent; leaves (autumn), 0.06 per cent. The total ash in the above (dry material) was 6.403, 7.719, and 7.005 per cent respectively.

Stoklasa, J. (Ann. Agron., 23 (1897), p. 588), in connection with a study of the condition of phosphoric acid in the soil made laboratory experiments with salts of known composition which led to the conclusion that the water-soluble portion of superphosphates never contains acid ferrous phosphate, this salt changing almost immediately upon its formation into di-tri-ferriphosphates of varying composition insoluble in water. The addition of ferrous salts to soluble phosphates results in the formation of di-tri-ferriphosphates unless an excess of free phosphoric acid is present. Acid ferric phosphate may be found in superphosphates only when there is at least 30 per cent of free phosphoric acid present. If this is not the case, the acid ferric phosphate may be transformed into mono-di-tri-ferriphosphate, $Fe_2O_3(P_2O_5)_2 . 8H_2O$.

"It is thus seen that the retrogression of phosphoric acid in superphosphate is very largely dependent upon the free phosphoric acid present. Aluminium salts do not behave like iron salts in superphosphate, but like the salts of lime and magnesia.

"Pot experiments with barley on a fertile soil containing 0.63 per cent calcium carbonate and 2 per cent of humus and treated with different phosphates of calcium, aluminium, and iron showed that the effect of the acid phosphates of these elements was almost the same. The tribasic phosphates were about one-half as effective as the acid phosphates. The effect of the normal reverted phosphates was about one-half greater than that of the tribasic phosphates."

Other conclusions regarding phosphates were drawn.

Strawinski, J. Frank (Amer. Jour. Pharm., 70 (1898), p. 189), finds that the ash of the rhizome and rootlets of plantain (*Plantago major*) amounted to 24.70 per cent and contained alumina in addition to other constituents.

Strohecker, R. (Arch. Pharm., 2d ser., 145, p. 131; Jour. Chem. Soc. London, 24 (1871), p. 428), in an article on chemical substitution in plants discusses analyses by Wittstein of water from the Ohe and Isar rivers and of the ash of *Fontinalis antipyretica* taken from these waters. The river waters contained respectively 0.016 and 0.2250 per cent total solids; in that of the Ohe water 0.108 per cent was Al_2O_3. The plants from the two rivers contained 22.60 and 9.88 per cent ash respectively, of which 9.272 and 1.616 per cent was Al_2O_3.

Struckmann (Ann. Chim. Pharm., 97, p. 143; Jour. Prakt. Chem., 68, p. 379; Chem. Centbl., 1856, p. 187; Jahresb. Chem., 1856, p. 687) found 9.2 per cent ash in the root (Wedel) of male fern (*Aspidium filix mas*) (dried at 100°), and 8.1 per cent in that of asplenium (*A. filix femina*), the ash containing respectively 2.40 and 2.20 per cent Al_2O_3.

Teller, G. L. (Arkansas Station Bulletin 42, pp. 75, 77), reports complete analyses of whole wheat, wheat flour, and other milling products, the samples being all obtained from the same lot of winter wheat grown in Arkansas. The data regarding alumina follow:

ALUMINA IN ASH OF WINTER WHEAT AND ITS MILLING PRODUCTS.

	Patent Flour	Straight Flour.	Low Grade	Dust-room.	Ship-stuff.	Bran.	Wheat.
	Per Ct	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.
Total ash...........	0.31	0.40	0.70	2.50	3.08	5.25	1.62
Aluminium oxid in ash..............	.41	.15	.12	.04	.18	.07	.11

The presence of alumina in wheat has been attributed to the wearing down of the millstones. On this point Professor Teller says:

"This could not have been a source of the material in these mill products, as the wheat was crushed entirely by iron rollers, and an examination of the amounts of alumina found in the mill products and in the whole grain indicate that it is no more foreign to the true ash than any of the other constituents named. To bring further proof on this point, 100 gms. of the unground wheat was carefully washed with distilled water and, after drying, was burned without being pulverized. The same amounts of both alumina and zinc were found as in the wheat which had not been washed. It seems a little remarkable that the zinc should have accumulated to the greatest extent in the ash of the bran, while the alumina and silica should have reached their largest proportion in the ash of the finer flours. Alumina is found to be of frequent occurrence in the mineral waters of this State."

To ascertain whether alumina is present in the ash of wheat grown on a very sandy soil, a sample of wheat was obtained which had grown on a sandy soil in Michigan. This was examined for alumina and none was found

Thielau (Vierteljahresschr. Prakt. Pharm., 4, p. 537; Pharm. Centbl., 1855, p. 811; Jahresb. Chem., 1855, p. 728) found 3.33 per cent ash in ergot (*Secale cornutum*) dried at 100°. Of this 0.29 per cent was Al_2O_3.

Thomas, Mason B. (Proc. Indiana Acad. Science, 1893, p. 239), in a report on the study of the ash of trees makes the following statements:

"The substances usually found in the ashes of all trees when burned at a low temperature are potash, soda, lime, magnesia, and iron (K_2O, Na_2O, CaO, MgO, Fe_2O_3) in combination with phosphoric acid (P_2O_5), sulphuric acid (SO_3), chlorine (Cl), carbon dioxide (CO_2), and silica (SiO_2); iodine (I), aluminium (Al), and manganese (Mn) are often present. One portion of these mineral constituents exists in solution in the sap and the other in the tissue of the plant in the solid form."

The author reports the ash constituents usually determined, but does not report the amount of aluminium present. His experiments were made with common forest and fruit trees.

Tod, W. (Arch. Pharm., 2d ser., 78 (1854), p. 136; Jour. Prakt. Chem., 62, p. 503; Pharm. Centbl., 1854, p. 452; Jahresb. Chem., 1854, p. 665), found that the flesh of plum (*Prunus domestica*) made up 93 per cent of the fruit and the pit 7 per cent. The fresh flesh contained 0.407 per cent ash, 0.003 per cent being Al_2O_3.

Tollens (Jour. Landw., 50 (1902), p. 231) states that aluminium is always present in very small quantities in grain.

Trimble, H., and **H. J. Schuchard** (Amer. Jour. Pharm., 57 (1885), p. 21) report the analysis of the tops and leaves of water pepperwort (*Polygonum hydropiper*). The ash constituted 7.4 per cent of the total plant and contained aluminium phosphate.

Tschirch, A. (Gartenzeitung, 1883, p. 34), reports in hyacinth (*Hyacinthus orientalis*) 10.11 per cent dry matter and 8.5787 per cent pure ash. The Al_2O_3 in the ash was 0.8871 per cent.

Tucker, G. M., and **B. Tollens** (Ber. Deut. Chem. Gesellsch., 32 (1899), p. 2575; Jour. Chem. Soc. London, 78 (1900), II. p. 35) note $Al_2O_3 . Fe_2O_3$ in plane-tree leaves.

Vielguth (Vierteljahressch. Prakt. Pharm., 5, p. 187; Chem. Centbl., 1856, p. 423; Jahresb. Chem., 1856, p. 690) notes 7.6 per cent ash in bed straw (*Galium mollugo*) (whole plant). This contained 0.3 per cent Al_2O_3.

Völcker, A. (Rpt. 19th Meeting British Association; Notes and Abstracts, p. 43, Jahresb. Chem., 1850, p. 672 and Table D, p. 661), notes 1.97 per cent alumina in the ash of *Armeria maritima* (green plant?). The amount of total ash was not stated.

Wallace (Analyst, 3 (1878), p. 243) reports that the ash of sugar made from cane growing near the seacoast in Demerara contained, in addition to other constituents enumerated, 0.65 per cent aluminium. The amount of total ash is not stated.

Walz (Jahrb. Prakt. Pharm., 15, p. 65; Jahresb. Chem., 1847–48, p. 1083; and Table B, p. 1074) reports ash as follows in grapevine and leaf: Clevner, 6.19 per cent; Riesling, 7.74 per cent; Drollinger, 6.00 per cent. Of this 1.15, 0.91, and 1.00 per cent respectively was aluminium phosphate.

Wanklyn, J. A., and **W. J. Cooper** (Bread Analysis, London, 1886, pp. 22, 24, 25) state that according to their analyses the ash of flour contains 1.3 per cent Fe_2O_3 and Al_2O_3 together. In eight samples of flour analyzed, 100 gms. of material yielded from 0.01 to 0.02 gm. of phosphate of iron and alumina. In eight samples of bread, the ash in 100 gms. of material ranged from 0.890 gm. to 1.742 gms.; the phosphates of iron and alumina from 0.006 gm. to 0.014 gm.

Warden, C. J. H. (Chem. News, 38, p. 146; Jahresber. Agr. Chem., 1878, p. 106), reports a trace of Al_2O_3 in the ash of opium from Behar, India.

Warden, C. J. H. (Chem. News, 39, p. 27; Jahresb. Chem., 1879, p. 927), reports 0.9701 per cent Al_2O_3 in the ash of poppy leaves or petals used to wrap up opium. The total amount of ash is not stated.

Warden, C. J. H. (Chem. News, 64 (1891), p. 161), reports 24.334 per cent ash in the leaves (dried at 100°) of prickly chaff flower (*Achyranthes aspera*), an Indian weed. Of this 2.0651 per cent was Al_2O_3. The author says that there was considerable soil which it was not possible to separate from the leaves. This would, of course, increase the Al_2O_3 content.

Wasowicz, D. v. (Pharm. Jour. Trans., 3d ser., 10, pp. 301, 341, 463; Arch. Pharm., 3d ser., 14 (1879), p. 193; Jahresb. Chem., 1879, p. 927), notes the presence of aluminium in the ash of the root of an aconite (*Aconitum heterophyllum*). The total ash was equal to 2.331 per cent. The root of another aconite (*Aconitum japonicum*) contains 2.799 per cent ash. Aluminium is reported as a constituent of this also.

Watts, H. (Phil. Mag., 3d ser., 32, p. 54; Jahresb. Chem., 1847–48, p. 1077; and Table A, p. 1074), reports 6.5 per cent ash in hop blossoms; of this 1.18 per cent was alumina.

Way, J. T., and **G. H. Ogston** (Jour. Roy. Agr. Soc., 11, pt. 2, p. 497; Jahresb. Chem., 1850, p. 666, Table A, p. 660) note 1.90 per cent ash in rye (dry material). Of this 0.50 per cent was alumina.

Weber, R., and **E. Ebermayer** ("Lehre der Waldstreu," Berlin, 1876. Cited by Wolff in "Aschen Analysen," Berlin, 1880, pt. 2, pp. 87, 130) determined the Al_2O_3 in fir litter, i.e. needles, etc., under fir trees. The pure ash in eleven analyses ranged from 1.07 to 2.00 per cent. From 1.09 to 9.98 per cent of the total pure ash was found to be Al_2O_3.

Weber and **Ebermayer** ("Lehre der Waldstreu," Berlin, 1876. Cited by Wolff in "Aschen Analysen," Berlin, 1880, pp. 100, 131) also give figures showing that the pure ash of white pine litter ranges from 1.99 to 5.27 per cent. Of this 1.44 to 7.02 per cent was found to be Al_2O_3.

Wefers-Bettink, H. (Rev. Trav. Chim. Pays-Bas, 2, p. 126; Jahresb. Chem., 1883, p. 1496), analyzed "Lĕgèn," a Japanese drug, which has been said to consist largely of the excrement of an insect, "Dendang." He concluded that it was of vegetable origin and probably prepared from the seed of some strychnin-yielding plant. Lĕgèn contained 16.88 per cent ash, of which Al_2O_3 was one of the constituents.

Weigelt, C. H. (Jour. Prakt. Chem., 106 (1869), p. 193), reports 10.5 per cent pure ash in one specimen of *Parmelia scruposa;* of this 28.171 per cent was found to be Al_2O_3.

Wellborn, G. (Pharm. Jour. Trans., 3d ser., 9, p. 181; Jour. Chem. Soc. London, 1878, II, p. 1009), in a paper on the detection of alum in flour states that too much allowance has been made for alumina in wheat, as it is not an invariable constituent.

Wheeler, C. Gilbert (Erdman's Journal, 94, p. 385; Jahresb. Agr. Chem., 1865, p. 114), reports traces of Al_2O_3 in the ash of nine varieties of Bavarian hops.

Will and **Fresenius** (Chevallier et Baudrimont, "Dictionnaire des alterations," Paris, 1878, p. 1131) note the occurrence of alumina in the ash of Hungarian tobacco.

Winternitz (Vierteljahressch. Prakt. Pharm., 4, p. 542; Pharm. Centbl., 1855, p. 820; Jahresb. Chem., 1855, p. 722) found 8.88 per cent ash in dandelion (*Leontodon taraxacum*) (whole plant without root, dried at moderate temperature). Of this 0.402 per cent was Al_2O_3.

Witting (Keller and Tiedemann's Nord. American Monatsber. Pharm. Chem., 1851, p. 404; Jahresb. Chem., 1851, p. 712, Table C, p. 708) reports in ash of birch "No. 76" 1.38 per cent alumina and in "No. 74" 0.42 per cent, and in ash of beech "No. 75" 0.05 per cent. The amount of total ash is not stated.

Wittstein (Repert. Pharm., 2d ser., 46, p. 329; Pharm. Centbl., 1847, p. 739; Jahresb. Chem., 1847–48, p. 1082; and Table A, p. 1074) reports 1.56 per cent ash in green leaves of Virginia creeper (*Vitis hederacea*); of this 0.07 per cent was alumina.

Wittstein (Vierteljahressch. Prakt. Pharm., 3, p. 10; Pharm. Centbl., 1854, p. 12; Jahresb. Chem., 1853, p. 579) reports 1.13, 1.98, and 2.92 per cent ash in the bark of pine trees (Scotch pine) (*Pinus silvestris*), 220, 172, and 135 years old, respectively, which grew on the sandy soil of the "Hauptmoor," near Bamberg, the ash containing respectively 10.12, 4.49, and 3.08 per cent Al_2O_3. The wood from the trunks of these trees contained 0.45, 0.58, and 0.42 per cent ash with respectively 0.92, 0.72, and 0.26 per cent Al_2O_3.

Wittstein (Vierteljahressch. Prakt. Pharm., 4, p. 525; Jahresb. Chem., 1855, p. 722) reports two analyses (the first by Nutzinger; the second by Thielau) of the ash of heather (*Calluna vulgaris*) (whole plant, without root, in bloom): sample "a," grown on moorland, contained, air-dry, 2.876 per cent ash with 0.844 per cent Al_2O_3, and sample "b," grown on sandstone, contained, air-dry, 3.324 per cent ash with 0.513 per cent Al_2O_3.

Wittstein, G. C. (Arch. Pharm., 2d ser., 111, p. 14; Jahresb. Chem., 1862, p. 509), reports the following:

ALUMINA IN CERTAIN PLANTS.

Kind of Plant.	Total Ash.	Al_2O_3 in Ash.
	Per Cent.	Per Cent.
Reindeer moss (*Cladonia rangiferina*) dried at 160°; from Riefs, near Passau	1.18	1.805
Reindeer moss (*C. rangiferina*) from Frauenberge	1.325	1.694
Reindeer moss (*C. rangiferina*) from neighborhood of Sterz	0.905	1.948
Lichen (*Variolaria dealbata*) from Bärensteinleithe, near Grafenau; not well cleaned	18.20	7.495
Old man's beard (*Usnea barbata*) from Grafenau	1.426	1.653
Lichen (*Gyrophora pustulata*) from Veitsberge	3.00	4.069
Iceland moss (*Cetraria islandica*) from Bavarian forest	0.8	4.348
Sphagnum moss (*Sphagnum cuspiaatum*) from Upper Bavaria	2.014	2.834
White birch (*Betula alba*) from Bavarian forest; wood dried at 100°	0.864	0.663
White birch (*Betula alba*) from Bavarian forest; leaves dried at 100°	3.958	0.287
Beech (*Fagus sylvatica*) from Bavarian forest; wood	0.74	0.508
Beech (*Fagus sylvatica*) from Bavarian forest; leaves	4.3	0.162
Dwarf pine (*Pinus pumilio*) from Bavarian forest; wood	0.284	0.124
Dwarf pine (*Pinus pumilio*) from Bavarian forest; bark	1.375	0.240

These plants are discussed in relation to the material (rock or soil) on which they grew.

Wittstein (Vierteljahressch. Prakt. Pharm., 13, p. 364; Jahresb. Agr. Chem., 1865, p. 108) quotes an analysis showing that fresh fig leaves from plants grown on calcareous soil contain 0.286 per cent ash, 0.03 per cent of this being Al_2O_3.

Wittstein, G. C. (Ann. Chem. u. Pharm., 108, p. 203; Chem. Centbl., 1858; Jahresb. Agr. Chem., 1858–59, p. 121), reports the ash content of the different parts of a primrose (*Primula farinosa*). The following figures are quoted, being for material dried at 100°:

Root, 1.617; leaves, 0.955; stem, 0.539; flower heads, 1.145; and entire plant, 0.832 per cent Al_2O_3 respectively; or, differently stated:

Of the 0.832 per cent Al_2O_3 in the entire plant, 0.175 per cent was in the root, 0.198 per cent was in the leaves, 0.294 per cent was in the stem, and 0.165 per cent was in the flower head.

Wittstein, G. C. (Vierteljahressch. Prakt. Pharm., 16, p. 81; Jahresb. Chem., 1867, p. 769), reports alumina as follows in leaves and flowers of lilac (*Syringa vulgaris*), all dried at 110°.

ALUMINA IN DIFFERENT PARTS OF LILAC.

Part of Plant.	Ash.	Al_2O_3.
	Per Cent.	Per Cent.
Leaves (variety with white blossoms)	4.389	0.195
Leaves (variety with purple blossoms)	4.922	.188
Flowers (without calyx, variety with white blossoms)	5.76	.135
Flowers (without calyx, variety with purple blossoms)	4.286	.240

Wittstein, G. C. (Arch. Pharm. 3d ser., 8, p. 341; Jahresb. Agr. Chem., 1875–76, p. 139; Jour. Chem. Soc. London, 1877, I, p. 487), reports 5.936 per cent total ash in a spurge (*Euphorbia amygdoloides*) (whole plant) grown on soil rich in silicate and 4.85 per cent in another sample from similar soil. The ash of the first contained 1.057 and of the latter 1.325 per cent Al_2O_3.

Wittstein, G. C. (Arch. Pharm., 3d ser., 7 (1875), p. 394; Jour. Chem. Soc. London, 1876, I, p. 736), finds that the ash of the elder tree (*Sambucus nigra*) contains 0.250 per cent Al_2O_3.

Wittstein also reports (Arch. Pharm., 3d ser., 8 (1876), p. 229; Jahresb. Agr. Chem., 1875–76, pp. 132, 138) 94 per cent total dry matter in sunflower seeds (*Helianthus annuus*), the ash containing 0.23 per cent Al_2O_3 and 1.9 per cent ash, with 0.28 per cent Al_2O_3 in the whole plant.

Wittstein, G. C. (Arch. Pharm., 3d ser., 8 (1876), p. 342; Jahresb. Agr. Chem., 1875–76, p. 139), reports 7.132 per cent ash in *Herniaria glabra* (dry plant) grown in silicious soil and 6.622 per cent in plants grown on dolomite soil. The former contained 1.321 and the latter 1.755 per cent Al_2O_3.

Wolff, E. (Aschen Analysen, pt. 2, p. 128), cites figures showing that heather contains 2.08 per cent pure ash. It is stated that on an average 0.33 per cent of the total ash is Al_2O_3, the range in eleven analyses being from 0 to 2.3 per cent. Wolff aslo states (Aschen Analysen, p. 128) that in moss (the variety not given) the pure ash constituent is equal to 2.74 per cent on an average. Of this Al_2O_3 constitutes 2.35 per cent, the range in eleven analyses being from only 0 to 7.99 per cent. Wolff also states (Aschen Analysen, p. 128) that the pure ash content of lycopodium is 5.10 per cent, 39.17 per cent of this being Al_2O_3, the range of this constituent in six analyses being from 22.2 to 57.36 per cent.

Some of the data cited by Wolff were undoubtedly from early analyses, interesting chiefly from an historical standpoint.

Wolff, J. (Vierteljahressch. Prakt. Pharm., 3, p. 1; Jahresb. Chem., 1853, p. 562), found 1.2 per cent ash in air-dry birch fungus (*Birken schwamms*). Of this 3.14 per cent was Al_2O_3. The plant analyzed was without doubt the rough boletus (*Boletus scaber*), sometimes called Birken-pilz.

Wypfel, M. (23 Jahresb. Niederöster. Landes Realgym. Waldhofen, 1892, p. 22; Just's Jahresb. Bot., 20 (1892), I, 1, p. 425), studied the effect of chlorids on plant growth. Seedlings of corn (*Zea*), bean (*Phaseolus*), pea (*Pisum*), cucurbit (*Cucurbita*), sunflower (*Helianthus*), beet (*Beta*), onions, and *Hartwegia comosa* were watered daily with 0.5 to 2.0 per cent solutions of different chlorids. Among the conclusions drawn were the following: Chlorids which are widely distributed and which contain important material for plant growth (magnesium, calcium, potassium, and aluminium chlorid) at first had a favorable effect. Later, when they became more concentrated in the soil, they hindered growth and finally killed the plants. Magnesium chlorid was the least harmful, potassium and aluminium chlorids most harmful.

Yardley, H. B. (Chem. News, 79 (1899), p. 122; Jour. Chem. Soc. London, 76 (1899), II, p. 793), found 4.19 per cent ash in cardamon seeds and husks. Of this 1.53 per cent was Al_2O_3.

Yoshida, H. (Jour. Chem. Soc. London, 43 (1883), p. 472), reports a chemical study of lacquer (*Urushi*), the milky secretion of lac (*Rhus vernicefera*). Gum constitutes from 3 to 8 per cent of the original juice. A sample weighing 0.5267 gm. gave 0.0267 gm. ash. The ash was found to contain in addition to other constituents 7.85 per cent Al_2O_3.

Yoshida (Jour. Chem. Soc. London, 51 (1887), pp. 748–750) takes exception to the idea that alumina is not a normal constituent of flowering plants, as stated by Allen (Commercial Organic Analysis, vol. 1, p. 38). In the Japanese lacquer tree (*Rhus vernicefera*) alumina is present, apparently as an arabate.

According to the author the soil of the plain of Musashi, on which Tokyo is situated, is of volcanic origin and is remarkable for the large proportion of alumina in it which is soluble in hydrochloric acid. This gave promise that here, if anywhere, aluminium should certainly be found in flowering plants. He therefore examined a number of plants and flowers grown on the farm lands of the Imperial College of Agriculture at Komaba, near Tokyo. Each one was carefully picked over and all imperfect and soaked grains rejected.

Great care was taken to clean the grains and parts so as to remove all dirt. They were ground and incinerated, care being taken to avoid all possible contamination with clay or charcoal. The materials examined included soy bean (*Soja hispida*) (which the author calls "pea"), whole seed, cotyledons, and hull or skin, red bean (*Adzuki*) (*Phaseolus radiatus*), hill and paddy rice, wheat, barley, two sorts of millet, and buckwheat. The analytical methods are described in detail. The table beyond reports the results of. the analyses.

Of this work the author says: "It will be seen that I have found alumina in every case except that of the pea [*soja*], while in the hull or skin of the pea, one of the largest amounts of alumina occurs. The results here recorded may at least serve to indicate the propriety of reconsidering the accuracy of the dictum that aluminium is not a constituent of flowering plants."

ASH CONSTITUENTS OF A NUMBER OF PLANTS.

Kind of Plant.	Ash in Air-dried Sample.	In Ash.		
		Alumina.	Phosph. Acid.	Silica, etc.
	Per Cent.	Per Cent.	Per Cent.	Per Cent,
"Pea" (whole) (*Soja hispida*).....	....	0.053	33.48	
"Pea" (cotyledons) (*Soja hispida*)	4.22	.000	.....	0.50
"Pea" (hull or skin) (*Soja hispida*)	4.31	.268	5.66	3.60
Red bean (*Adzuki*) (*Phaseolus radiatus*)	2.60	.096	32.89	0.25
Rice (hill)	0.87	.161	51.33	9.36
Rice (paddy)	0.56	.189	52.79	10.99
Wheat	2.62	.106	65.55	1.31
Barley	1.09	.140	33.19	1.19
Millet (*Awa*) (*Panicum italicum*)..	1.68	.272	40.43	8.91
Millet (*Hiyé*) (*P. cruscorvi*).......	0.94	.185	39.87	8.62
Buckwheat	1.72	.113	1.94	0.81

Young, W. C. (Analyst, 2 (1878), p. 13), in an article on the estimation of alum in bread, reported that from bread containing no added alum he obtained 0.07 grain $Al.PO_4$ per 1000 grains.

Young, W. C., also reports (Analyst, 12 (1887), p. 29), in an article on "Sour Bread and the Logwood Test," that he found aluminium phosphate equivalent to 7.8 grains of alum in 4 pounds of bread which he subsequently learned contained no added alum. A second sample of the same bread yielded aluminium phosphate equivalent to 8 grains of alum in 4 pounds of bread. In his investigation he found that the logwood test as applied by him indicated the presence of aluminium in the samples of flour or bread examined which were known to contain no added alum, provided the sample underwent acid fermentation or was acidulated with acetic acid. In a discussion of his paper, W. Blythe states that all bread contains more or less alumina.

Young, W. C. (Analyst, 12 (1887), p. 145), reports later a continuation of his investigation. He found that the aluminium normally present in the flours he examined was contained in the gluten of the wheat and not in the starch, and was present in the form of aluminium phosphate. The following quotation is of interest in this connection:

"Another conclusion which may be fairly drawn from my results is that the alumina naturally present in flour is *combined* with the gluten. This being so, I thought it would be interesting to see if gluten would absorb alumina from a solution of alum. With this object I prepared some gluten, thoroughly dried it, and found the ash equal to 1.28 per cent. A portion of this gluten finely powdered was placed in a 2 per cent solution of alum and kept for some hours at a temperature of about 180° F.; it was then thrown on to a filter, thoroughly washed, and dried. The ash then amounted to 1.32 per cent. Taking into consideration the great difficulty of washing the gluten free from excess of alum, I do not think this slight increase of ash is due to absorption of alumina. Although the gluten does not appear to have the property of absorbing alumina from a solution of alum, yet its properties are affected in a marked degree by contact with such a solution, as it may then be kept moist in a warm place without giving any indication of decomposition, whilst ordinary gluten, as is well known, darkens in color, swells, and rapidly decomposes under similar circumstances."

Young, W. C. (Analyst, 13 (1888), p. 5), reports the determination of alumina in the best quality of Vienna flour, containing 0.7 per cent ash and about 8 per cent gluten. From 100 gms. of flour he obtained 0.0075 gm. of phosphate of alumina.

Of his experiment he says:

"The gluten was separated by washing in a muslin bag in the usual way, and when dried contained 1.26 per cent ash; 20 gms. of this dried gluten, finely powdered, was then treated with about 250 cc. of a mixture of equal volumes of acetic acid and water and heated in the water-bath for about twenty-eight hours. By this time the mass had become quite liquid, the gluten having lost its firmness in the same way that gelatin does under similar circumstances. After standing a short time the liquid was poured off and the sediment further treated with weak acetic acid twice, and the three portions of liquid evaporated to dryness, the sediment being rejected. In this way I think that any extraneous earthy matter present in the gluten was separated, and, therefore, only the natural alumina retained.

"The dried residue was then burnt to a perfect ash, the ash dissolved in dilute hydrochloric acid and filtered, the insoluble matter being well washed and weighed. The insoluble matter thus obtained weighed only 0.009 gm., and of this .0075 was silica.

"The insoluble matter was then fused with about twice its bulk of mixed alkaline carbonates, dissolved in dilute hydrochloric acid, and filtered. This filtrate was added to the acid solution of the ash, evaporated to dryness, redissolved in a small quantity of dilute hydrochloric acid, and filtered. The filtrate was then boiled and cautiously added to 25 cc. of a saturated solution of pure caustic soda, also boiling, and the whole kept boiling for a few minutes. It was then filtered, and the precipitate washed, the filtrate made slightly acid with hydrochloric acid, about 5 cc. of a saturated solution of sodium phosphate added, and finally a slight excess of ammonia. After boiling for about ten minutes, the precipitate of phosphate of alumina was collected and weighed. . . .

"In this way I obtained .0185 gm. of phosphate of alumina from 20 gms. of gluten. Now, as the flour contained 8 per cent of gluten, and gave originally .0075 per cent of phosphate of alumina, 20 gms. of gluten would be equivalent to 250 of the flour, which would yield .01875 of phosphate of alumina. So that practically I obtained the whole of the alumina of the flour in the gluten. As in the process of washing the starch from the gluten a large proportion of any foreign earthy matter that may have been present must have been separated, and any remaining eliminated by dissolving the gluten in acetic acid, there can be no doubt that the alumina obtained in this experiment was present as a natural constituent of the flour, and I think further that the interesting fact is established that the bulk of it is associated with the gluten."

Young, W. C. (Analyst, 15 (1890), p. 83), in a report of an investigation of the solubility of phosphate of alumina in acetic acid undertaken with special reference to the estimation of alumina in flour, bread, etc., makes the following statement: "I may mention that rye bread, of which I frequently have samples for analysis from the east end of London, invariably gives a strong reaction with a logwood test, although I have never found more than .008 gm. phosphate of alumina in 100 gms."

Yvon, M. (Jour. Pharm. et Chim., 4th ser., 25 (1877), p. 588), reports the ash analyses of *Thapsia garganica* from Hegeria and *T. sylphium* * from Asia, the former with 7.52 per cent and the latter with 5.746 per cent in the fresh plant. Of this 0.3 and 0.433 per cent respectively was said to be Al_2O_3.

Zeyer, N. (Vierteljahressch. Prakt. Pharm., 10, p. 504; Jahresb. Chem., 1861, p. 769), found 4.05 per cent ash in the bark of *Atherosperma moschatum* dried at 100°. Of this 0.191 per cent was Al_2O_3.

* There is an evident error in the names of the plants in the original tables as published. The names as quoted above have been corrected.

ALUMINIUM IN ANIMAL PRODUCTS.

Dieterich, E. (Vierteljahressch. Prakt. Pharm., 16, p. 56; Chem. Centbl., 1867, p. 287; Jahresb. Chem., 1867, p. 822), reports 3.2 per cent ash in cochineal (silver-gray Honduras variety); of this 1.390 was Al_2O_3.

Harrison and **Kinnicutt,** according to Rotch (Pediatrics, Philadelphia, 1896, p. 175), found 0.40 per cent iron oxid and alumina in the ash of woman's milk, the total ash ranging from 0.1 to 0.2 per cent. From the data at hand, the proportion of the ash constituents was recalculated, the value for iron oxid and alumina being given as 0.37 per cent. Silica was also found, and it is stated that this and alumina have not been noted in any previous analysis.

Data are also quoted by Rotch (loc. cit., p. 218) regarding the ash of cow's milk which it is said were reported by König, Forster, and others. The value given for total ash is 0.70 per cent, of which 0.44 per cent was iron oxid and alumina.

Heyl (Ann. Chem. Pharm., 62, p. 87, Repert. Pharm., 2d ser., 47, p. 231; Pharm. Centbl., 1847, p. 591: Jahresb. Chem., 1847–48, p. 938) notes 29.18 per cent aluminium silicate in a sample of officinal burned sponge (Schwammkohle).

Liebermann, C. (Ber. Deut. Chem. Gesellsch., 1885, p. 1969; Jahresb. Chem., 1885, p. 1847), estimates that cochineal yields 9 to 10 per cent pure coloring matter. In good cochineal carmine, he found 7 per cent ash. This contained a trace of Al_2O_3. Carmine is regarded as an aluminium-calcium-protein compound of the coloring matter present.

Mayrhöfer, J. (Chem. Centbl., 1891, I, p. 175; Jahresb. Chem., 1891, p. 2820), notes a trace of alumina in the ash of that portion of an abnormal leather which was soluble in cold water.

McMurtrie, W. (American Chemist, 4, p. 339; Watts' Dictionary, 1879, vol. 8, pt. 1, p. 765), finds in the excrements of the common bat 19.88 per cent of alumina.

Müntz, A. (Ann. Chim., 4th ser., 20, p. 309; Compt. Rend. Acad. Sci., Paris, 69, p. 1309; Bul. Soc. Chim., 2d ser., p. 379; Dingler's Polytech. Jour., 195, p. 466; Jahresb. Chem., 1869, p. 1149), in a study of the chemical changes in tanning, reports 0.6693 and 0.4670 per cent ash respectively in fresh, rather thin hide from a young cow, and very thick ox hide. The ash contained respectively 0.0930 and 0.0704 per cent $Al_2O_3.Fe_2O_3$.

Schütze, R. (Chem. Centbl., 1889, II, p. 588; Jahresb. Chem., 1889, p. 2156), found in the ash of the mantle of *Phallusia mammillaris* (after extraction with ether) 9.52 per cent Al_2O_3. The amount of ash is not stated.

Staffel (Arch. Pharm., 2d ser., 64 (1850), p. 148; Pharm. Centbl., 1851, p. 162; Jahresb. Chem., 1850, p. 573) found in veal (breast) free from fat and skin 77.64 per cent water, and in the dry material 3.1 per cent ash. This contained according to his analysis a trace of alumina. He also found a trace in the ash of beef. The fresh material contained 72.63 per cent water; the dry 2.2 per cent ash.

Theile, R. (Jenaische. Ztschr. Med., 3, p. 147; Ztschr. Chem., 1868, p. 125; Chem. Centbl., 1867, p. 296, 305; Vierteljahressch. Prakt. Pharm., 17, p. 197; Bul. Soc. Chim., 2d ser., 10, p. 153; Jahresb. Chem., 1867, p. 772), reports 2.3 per cent ash in egg albumen, 15.04 per cent of this being $Al_2O_3.PO_5$.

Thezard (Compt. Rend. Acad. Sci., Paris, 120 (1895), p. 1126; Jour. Chem. Soc., London, 68 (1895), II, p. 456) analyzed a very white, porous, and very brittle tibia from an adult human mummy from an Egyptian tomb of unknown age. In addition to other constituents, he reports 0.534 per cent Al_2O_3.

Walter, G. (Ztschr. Physiol. Chem., 13, p. 464; Jahresb. Chem., 1889, p. 2156), reports 28.165 per cent ash in the shell-like, outer covering of *Protopterus annectens* (air-dry). This contained 5.491 per cent Al_2O_3.

ALUMINIUM IN NATURAL WATERS.

Abbéne (Jour. Pharm., 3d ser., 12, p. 412; Pharm. Centbl., 1848, p. 47; Jahresb. Chem., 1847–48, p. 1009) notes traces of alumina in the water of the Prè Saint Didier upper and lower mineral springs at Courmayeur.

Adams, F. D. (Geol. and Nat. Hist. Survey, Canada, 1885. Chemical Contributions, p. 15, M), reports 0.0005 parts alumina per 1000 in water from a spring at Halowell Grant, near Antigonish, Nova Scotia. This water is used for medicinal purposes.

Adams, F. D. (Geol. and Nat. Hist. Canada, 1888–9. Chemical Contributions, p. 17, R.), in an analysis of water from a boring in the west half of Lot 26, in the fourth range of Otanabee, Peterborough County, Ontario, reports 0.0008 part alumina per 1000.

Agrestini, A. (Gaz. Chem. Ital.; Jour. Chem. Soc. London, 64 (1893), II, p. 175), found in the hepatic mineral spring water of the Valle del Gallo, near Urbino, 0.0005 $AlPO_4$ per 1000 gms.

Aillaud (Compt. Rend. Acad. Sci., Paris, 95, p. 104; Jahresb. Chem., 1882, p. 1627) reports 0.007 gm. $Al_2S_3O_{12}$ per 1000 cc. in high water from the Rio Grande which was used for the water supply of Panama.

Aillaud (Compt. Rend. Acad. Sci. Paris, 95, p. 104; Jahresb. Chem., 1882, p. 1637) reports 0.020 gm. Al_2O_3 per 1000 cc. in well-water from Emperador, Panama, and 0.011 gm. Al_2O_3 in water from a second well in the same locality.

Allemann, H. (Wiener Akad. Ber., 56 (2. Abt.), p. 47; Wiener Akad. Anz., 1867, p. 135; Jour. Prakt. Chem., 101, p. 317; Chem. Centbl., 1867, p. 423; Inst. 1867, p. 341; Jahresb. Chem. 1867, p. 1039), in an analysis of the Sauerbrunn at Ebriach in Karnthen, reports 0.034 part Al_2O_3 and 0.015 parts aluminium phosphate per 10,000.

Andouard (Jour. Chim. Med., 3d ser., 5, p. 466; Jahresb. Chem., 1849, p. 617) found 0.003 gm. aluminium phosphate and 0.006 gm. alumina per 1000 cc. in mineral water from Villecelle, near Lamalou (Hérault).

Andouard, A. (Jour. Pharm., 4th ser., 9, p. 336; Jahresb. Chem., 1869, p. 1291), reports two analyses of Beaupréau spring-water from Dep. Maine-et-Loire. It contained 0.022 and 0.010 gm. Al_2O_3 per 10,000 gms. The second analysis was made with a sample taken after heavy rain.

Ashley, J. M., E. T. Bennett, and **T. J. Herapath** are quoted (Jahresber. Chem., 1849, p. 620) as reporting traces of aluminium in Thames water near London Bridge, Thames water at Greenwich, and mineral water from Kingswood, near Bristol, respectively.

Avequin (Jour. Pharm., 3d ser., 32, p. 288; Jahresb. Chem., 1857, p. 729) notes 1.753 grains alumina per gallon (=58,372 grains) in Mississippi River water taken at Carrollton, a few miles above New Orleans, Louisiana.

Bailey, E. H. S., in an extended treatise entitled "Special Report on Mineral Waters" (University Geol. Survey of Kansas, vol. 7), gives analytical data regarding the composition of a large number of waters in Kansas. The following table summarizes the data concerning alumina in these waters.

ALUMINA IN KANSAS MINERAL WATERS.

	Analyst.	Page.	Alumina per Liter.
The Chlorid Group.			Grams.
Arkansas City Well	E. H. S. Bailey	131	0.0266
Eureka Mineral Well	E. H. S. Bailey	137	.0017
Geuda Spring, No. 4	Bailey and Franklin	147	.0158
Bromo-magnesium Well	E. H. S. Bailey	150	trace
Geyser Mineral Well	E. H. S. Bailey	157	.0178
The Sulphate Group.			
Burr Oak	G. H. Failyer and C. M. Breese	169	.1175
Capioma Mineral Well	E. H. S. Bailey	170	.0103
Carbondale Spring	E. H. S. Bailey	172	.0096
Centralia Gypsum Well	E. B. Knerr	173	.0070
Conway	Failyer and Breese	173	.0104
Chlor-Sulphate Group.			
Merrill Spring	A. Merrill	196	.0034
Great Bend Mineral Well	E. H. S. Bailey	197	trace
Great Spirit Spring, No. 2	Bailey and Rice	205	.0166
Lincoln Springs, No. 1	Bailey and Franklin	207	.0005
Lincoln Springs, No. 2	Bailey and Franklin	208	.0047
Lincoln Springs, No. 3	Bailey and Franklin	209	.0034
Carbonate Group.			
Dixon Spring	E. B. Knerr	219	trace
Kickapoo Springs	E. H. S. Bailey	237	.0011
Sulfid Group.			
Cherokee City Well	Bailey and Hull	260	.0037
Columbus Well	Failyer and Willard	262	trace
Fort Scott Sulfo-magnesian Well	E. H. S. Bailey	266	.0144
Moss Springs Well	G. H. Failyer	268	.0241
Wakefield Sulfur Well	Bailey and Porter	271	.0530
Chalybeate (Iron) Group.			
Atchison Electric Light Well	E. B. Knerr	280	.0567
McDuff's Spring	E. B. Knerr	281	.0120
Special Group.			
Lithium Spring, Omio	Failyer and Willard	307	.1940
Providence Mineral Well	J. H. Banks	308	trace
Soft-water Group.			
Atchison Parker's Spring	E. B. Knerr	311	.0032

Bailey quotes analyses of a number of waters for purposes of comparison, but does not cite the original place of publication. The following table shows data regarding the occurrence of alumina in such as have not been noted from other sources.

ALUMINA IN A NUMBER OF WATERS.

	Analyst.	Page.	Aluminium Chlorid per Gallon.	Aluminium Phosphate per Gallon.	Alumina per Gallon.	Aluminium Sulphate per Gallon.
			Grains.	Grains.	Grains.	Grains.
Oranien Quelle, Kreuznach, Rhenish Prussia........	Liebig	160	......	.760		
Dead Sea...........	......	161	31.37			
Carabana, Spain.....	A. Proust	192	......	......	.029	
Friedrichshall, Saxe-Meiningen, Germany	Bauer	215	.56			
Apollinaris, Germany.	Bischoff	246	......	......	1.20	
Sulphur Spring, Aix-les-Bains, France..	Bonjeau	273	......	......	......	3.200
Excelsior Sp'gs, Mo.	Woodward and Rob'tson	301	......	......	.297	
Sparta Artesian Well, Wisconsin........	J. M. Hirsch	301	......	.048		

Bailey, E. H. S., and **Mary A. Rice** (Trans. Kansas Acad. Sci., 14 (1896), p. 40; Jour. Chem. Soc. London, 72 (1897), II, p. 109) report 1.66 parts Al_2O_3 per 100,000 in water from a mineral spring in Mitchell County, Kansas, near Cawker City.

Baker, W. H. (Dingler's Polytech. Jour., 218, p. 267; Jour. Chem. Soc. London, 1876, I, p. 890), notes 55.128 grains $Al_2(SO_4)_3$ per gallon in the water of a *swallet* in the Empire mine of the Luzerne Company.

Ballo, M. (Ber. Deut. Chem. Gesellsch., 1878, p. 1900; Jahresb. Chem., 1878, p. 1306), notes 0.0017 Al_2O_3 (with a trace of P_2O_5) per 1000 in a thermal spring at the foot of the Blocksberg.

Ballo, M. (Ber. Deut. Chem. Gesellsch., 1878, p. 1902; Jahresb. Chem., 1878, p. 1305), in two samples of Ofener Bitter Wasser reports 0.229 and 0.089 parts Al_2O_3 (with P_2O_5) per 10,000, respectively.

Ballo, M. (Russ. Ztschr. Pharm., 22, p. 68; Jahresb. Chem., 1883, p. 1945), notes 0.0229 part Al_2O_3 per 1000 parts in the bitter water of the Victoria well at Ofen, Hungary.

Ballo, M. (Ber. Deut. Chem. Gesellsch., 1884, p. 673; Jahresb. Chem., 1884, p. 2035), reports 0.00952 gm. Al_2O_3 per 1000 cc. in Borhegyer Sauerwasser from Bibarczfalva, Austria-Hungary.

Barth, L. v., and **R. Wegscheider** (Wiener. Klin. Wochensch., 1891, No. 8; Jahresb. Chem., 1891, p. 2620) report 0.3575 gm.

Al_2O_3 per 10,000 gms. in mineral spring water from Mitterbad, Ultenthale, Tirol.

Barzilowski, J. (Ber. Deut. Chem. Gesellsch., 1884, p. 183; Jahresb. Chem., 1884, p. 2037), notes 0.0055 part Al_2O_3 per 1000 parts in Tokiew mineral water; and 0.103 part Al_2O_3 per 1000 parts in Alexandro-Jermolowski mineral water, both from the Caucasus.

Bauck, G. (Analyse der Salzsoolen von Colberg, Inaug. Diss. Göttingen, 1860; Jahresb. Chem., 1860, p. 830), reports alumina (parts per 10,000) in Colberg, Germany, saline mineral water as follows: Salinensoole, 0.011; Zillenbergsoole, 0.008, and Marktsoole, 0.006.

Bechamp, A. (Compt. Rend. Acad. Sci. Paris, 62, p. 1088; Jour. Pharm., 4th ser., 3, p. 448; Jour. Prakt. Chem., 98, p. 189; Chem. Centbl., 1866, p. 864; Jahresb. Chem., 1866, p. 998), found 0.0052 gm. alumina per 1000 cc. in Thérèse sulphur spring at Fumades (Arrondissement d'Alais), and (Compt. Rend. Acad. Sci. Paris, 62, p. 1034; Bul. Soc. Chim., 2d ser., 6, p. 9; Inst. 1866, p. 173; Jour. Pharm., 4th ser., 3, p. 444; Jour. Prakt. Chem., 98, p. 190; Chem. Centbl., 1866, p. 864; and Compt. Rend. Acad. Sci. Paris, 63, p. 559; Jahresb. Chem., 1866, p. 998) also reports 0.00106, 0.0008, and 0.0011 gm. alumina per liter respectively in Dulimbert, Bouillants, and Granier mineral springs at Vergèze, Dép. du Gard.

Becker, G. F. (U. S. Geol. Survey Mon. 13, p. 265), quotes an analysis of water from Borax Lake, Cal., by Melville (Geol. Survey Cal., 1, p. 98) which showed 0.0029 gm. Al_2O_3 per liter. Becker (pp. 347 and 349) also gives an analysis of the water of Steamboat Springs, Nevada. The Al_2O_3 present was 0.0025 gm. per 10 liters.

Bell (Chem. News, 21, p. 83, from Amer. Jour. Pharm.; Jahresb. Chem. Naumann, 1870, p. 1392) notes traces of Al_2O_3 in a mineral spring in New York in the Adirondack region.

Bender, R. (Arch. Pharm., 3d ser., 11 (1877), p. 50; Jour. Chem. Soc. London, 1878, II, p. 18), notes that Fresenius found 0.00013 parts $AlPO_4$ per 1000 in Heilbrunnen mineral spring water, a spring situated near Lake Taach, and in the water of the Stahlbrunnen at Wassenach, 0.00045 $AlPO_4$.

Bender, R. (Arch. Pharm., 2d ser., 185 (1868), p. 5; Jahresb. Chem., 1868, p. 1035), reports 0.005, 0.182, and 0.045 Al_2O_3 per 10,000 parts respectively in the Victoria, Angustus, and Cold Spring III. These waters are all from the thermal springs of Neuenahr.

He also reports per 10,000 parts 0.176 Al_2O_3 in the old or small Sprudel spring No. I and 0.19 $Al_2O_3 + Fe_2O_3$ in the new or large Sprudel No. II. The Marien Sprudel contained 0.06 $Al_2O_3 + Fe_2O_3$.

Bensemann, R. (Chem. Centbl. Ausz., 1882, p. 186; Jahresb. Chem., 1882, p. 1629), reports 0.0026 Al_2O_3 per 100 in a Soolquelle at Kammin, Germany.

Berlin, N. J. (Oefversigt. K. Vetenskops. Akad. Förhl., 1863, p. 221; Jahresb. Chem., 1865, p. 939), notes 0.00794 part alumina per 10,000 in Torpasaltkälle at Lilla Edet in Sweden.

Bertoni, G. (Gaz. Chem. Ital., 14 (1884), p. 232; Jahresb. Chem., 1884, p. 2035), in an analysis of the Acquarossa Spring at Biasca, Italy, notes 0.0485 gm. Al_2O_3 per 1000 cc.

Billot, E. (Jour. Chim. Med., 3d ser., p. 569; Jahresb. Chem., 1853, p. 716), reports alumina (gm. per 1000 cc.) in water from Besançon, France, as follows: Doubs, 0.002; spring-water from the Grand Rue, 0.0094.

Bizio (Wiener. Acad. Ber., 41, p. 335, Rep. Chim. Pure. 2, p. 390; Jahresb. Chem., 1860, p. 837) reports (parts per 10,000) 0.0371 Al_2O_3 in the St. Gothard Spring water from Ceneda, Italy.

Bizio, G. (Atti. Imp. Reg. Inst. Venato Sci. Let. ed Arti., 3d ser., 11; Jahresb. Chem., 1865, p. 940), notes 7.7507 alumina per 10,000 in mineral water from Civillina.

Bizio, G. (Gaz. Chim. Ital., 10 (1880), p. 43; Jahresb. Chem., 1880, p. 1529), reports new analyses of the springs of Civillina, Italy. The old basin contained 1.28414 gms. aluminium sulphate; the new basin, 1.50764 gms. aluminium sulphate per 1000 gms.

Blondeau (Compt. Rend. Acad. Sci. Paris, 30, p. 481; Pharm. Centbl., 1850, p. 910; Jahrb. Chem., 1850, p. 621) notes the occurrence of aluminium salts as among the ordinary constituents of water of brooks, rivers, and springs. Water containing 0.4 to 0.5 gm. total mineral matter per liter is regarded as satisfactory for household purposes.

Blondeau (Compt. Rend. Acad. Sci. Paris, 35, p. 147; Inst. 1852, p. 238; Jour. Prakt. Chem., 57, p. 244; Jahresb. Chem., 1852, p. 756) reports 0.0016 gm. alumina (per 1000 gms.?) in water from Salles-la-Source, Aveyron.

Bobierre and **Moride** (Compt. Rend. Acad. Sci. Paris, 32, p. 376; Inst. 1851, p. 90; Jour. Pharm., 3d ser., 20, p. 244; Jahresb. Chem., 1851, p. 666) note 0.401 gm. total solids per 1000 cc. in mineral water from Kirouars, France; this contained a trace of alumina. The same authors (Compt. Rend. Acad. Sci. Paris, 33, p. 322; Inst. 1851, p. 306; Pharm. Centbl., 1851, p. 748; Jahresb. Chem., 1851, p. 666) noted 0.350 gm. total solids per 1000 cc. in mineral water from La Bernerie, France. This contained 0.6 per cent alumina.

Bolley, P., and **F. Schweizer** (Ann. Chem. Pharm., 106, p. 237; Chem. Centbl., 1858, p. 600; Jahresb. Chem., 1858, p. 800) found 0.0103 (gm.?) alumina per 1000 cc. in the sulphur water from Schinznach, Switzerland.

Bolley, P., and **Brigel** (Schweiz. Polytech. Ztschr., 1865, p. 47; Ztschr. Chem., 1865, p. 639; Jahresb. Chem. 1865, p. 936) report 0.0130 alumina per 1000 parts in the sulphur spring A at Lostorf in the Jura.

Bosshard, E. (Chem. Centbl., 1892, II, p. 1039; Jahresb. Chem., 1892, p. 2689), reports 0.00057 gm. Al_2O_3 per 10,000 gms. in the Old Spring water at St. Moritz in the Engadine and 0.00040 gm. Al_2O_3 per 10,000 gms. in Paracelsus spring water from the same locality.

Boussingault (Compt. Rend. Acad. Sci. Paris, 78, pp. 453, 526, 593; Ann. Chim. Phys., 5th ser., 2, p. 76; Arch. Pharm., 3d ser., 5, p. 354; Jahresb. Chem., 1874, p. 1337) reports 0.4028 gm. Al_2O_3 per liter in the water of the Rio Vinagre, near the falls of San Antonio, Colombia, a volcanic region, and 0.500 gm. per liter in a hot spring at the foot of the Ruiz volcano.

Boutel, G. F., examined the mineral waters of Saint Nectaire (Ann. Chim. Phys., 6th ser., 7, p. 536; Jour. Chem. Soc., London, 50 (1886), II, p. 858) and reported per liter 0.0330 gm. Al_2O_3 in Source Rouge and 0.0239 gm. in Source du Mont Cornador.

Braconnot (Jour. Chim. Med., 3d ser., 7, p. 737; Jahresb.

Chem., 1851, p. 665) notes 0.0080 gm. silica and alumina per 1000 cc. in the Luxeuil Spring.

Brignone, G. (Gaz. Chem. Ital., 14 (1884), p. 42; Jahresb. Chem., 1884, p. 2036), found in water from the island of Pantelleria (Italy), 0.00245 gm. $Al_2O_3 . P_2O_5$ per 1000 cc.

Buchner, A. (Jour. Prak. Chem., 102, p. 209; Neue Repert. Pharm., 16, p. 481; Neue Jahrb. Pharm., 28, p. 292; Jahrb. Chem. Will., 1867, p. 1036), found 0.00104 gm. alumina per liter in potable water from the spring at Neumarkt, Oberpfalz, Bavaria.

Buchner, L. A. (Neue Rep. Pharm., 17, p. 357; Jour. Chem., 104, p. 360; Jahresb. Chem. Will., 1868, p. 1037), reports traces of alumina in the sulphur spring at Oberdorf in Allgäu.

Buchner, M. (Wiener. Akad. Ber., 2. Abt., 71, p. 309; Jahresb. Chem., 1875, p. 1296), notes 0.0274 parts aluminium phosphate per 10,000 in Moriz spring-water from Sauerbrunn, near Rohitsch, Austria.

Buchner, M. (Chem. Centbl., 1876, p. 789; Jour. Chem. Soc. London (1877), II, p. 176), in the water of the Tempelbrunnen at Rohitsch, notes 0.0095 parts ($=AlPO_4$) per 100,000.

Buchner, M. (Chem. Centbl., 1881, p. 567; Jahresb. Chem., 1882, p. 1631), found 0.0249 parts $Al_2O_3.P_2O_5$ per 10,000 in the Lindenbrunnen at Zlatten, Austria-Hungary.

Bull (Silliman's Amer. Jour., 2d ser., 4, p. 385; Pharm. Centbl., 1848, p. 319; Jahresb. Chem., 1847–48, p. 999) reports 0.14 gm. alumina per 10,000 gm. in spring-water from Hartford, Connecticut.

Bunsen (Neue Jahresb. Pharm., 2, pp. 190, 194; Pharm. Centbl., 1854, p. 931; Jahresb. Chem., 1854, p. 758) examined a number of mineral waters, reporting aluminium phosphate (parts per 1000) as follows: Sophienquelle, 0.0033; Petersquelle, 0.0071, and Salzquelle, 0.0035, all at Petersthal.

Bunsen, according to Riegel (Neue Jahresb. Pharm., 9, p. 301; Jahresb. Chem., 1858, p. 794), found 0.007 part alumina per 10,000 parts in water from the Elizabethenquelle at Rothenfels, Baden.

Bunsen (Beiträge zur Statistik der inneren Verwaltung des Grossherzthums Baden, 11, Nos. 30, 43, and 56; Jahresb.

Chem., 1861, p. 1090) in Baden mineral springs notes alumina as follows (parts per 10,000): Ursprung, 0.011; Judenquelle, 0.011; Brühquelle, 0.009; Murquelle, trace, and Rothenfelser Mineralquelle, 0.007.

Bunsen and **Kirchoff** (Poggendorf's Ann., 113, p. 358; Phil. Mag., 4th ser., 22, p. 344; Jahresb. Chem., 1861, p. 1092) note 0.001 alumina (parts per 10,000) in the Umgemach thermal spring (Baden-Baden) and note 0.00020 in saline water from Dürkheim.

Burrell, B. A. (Jour. Chem. Soc. London, 69 (1896), p. 536), in an analysis of the water of the dropping well at Knaresborough in Yorkshire, notes a trace of alumina.

Carius, L. (Ann. Chem. Pharm., 137, p. 106; Jahresb. Chem. Will., 1866, p. 987), notes in the Ottilienquelle, Badequelle, and Marienquelle from the Inselbad near Paderborn, 0.009, 0.009, and 0.004 grams alumina per 10,000 respectively.

Carnelley, T. (Chem. News, 31, p. 27; Jahresb. Chem., 1875, p. 1298), reports in a spring (iron) near Trefriw, Wales, 233.3 parts aluminium per million. An earlier analysis by Hassal (Chem. News, 31, p. 27; Jahresb. Chem., 1875, p. 1298) gives 112.4. These values correspond to 1358.9 aluminium sulphate and 3.2 aluminium phosphate, and 707.7 aluminium sulphate, and 0.0 aluminium phosphate per million respectively.

Carnot, A. (Ann. Mines, 9th ser., 6 (1894), p. 355), reports a series of analyses of French mineral waters made at the École du Mines, containing data for the period from January, 1885, to June, 1894. The following contained alumina (grams per liter): "Sources de Fraysse, No. 1," Commune de Cransac, Département l'Aveyron, 0.0016; "Sources de Fraysse, No. 2," 0.0840, which were calculated to be equal to 0.0087 and 0.2790 gm. $Al_2(SO_4)_3$ respectively. The "Sources Roques" and "Rouquette," Cransac, Département l'Aveyron, contained respectively 0.0093 and 0.0071 Al_2O_3 equal to 0.0300 and 0.0230 aluminium sulphate. The "Sources No. 2," Cransac, contained 0.1340 Al_2O_3=0.4462 aluminium sulphate. Water from the Briscous salt-wells, Commune Briscous, Département Basses-Pyrénées, 0.0050 Al_2O_3 (with traces of Fe_2O_3). (See also Compt. Rend. Acad. Sci. Paris, 111, p. 192.)

Carnot, A. (Ann. Mines, 9th ser., 16 (1899), p. 33), reports a later series of analyses of mineral waters made at the laboratory of the École Nationale superieure des Mines, July, 1894–June, 1899. In the following, alumina was reported (grams per liter): "Source Saint-Louis," Département de la Drome, 0.1650 (=0.5505 aluminium sulphate); spring, Canton et Arrond. de Bagnères-de-Bigorre, Département Hautes-Pyrénées, 0.00060.

Casali, A. (Staz. Sper. Agr. Ital., 19, p. 509; Jahresb. Chem., 1890, p. 2658), notes traces of aluminium in potable water from Bologna, Riggio-Emilia, Ferrara, and Ancona.

Casselmann, W. (Jahrb. Ver. Naturk. Herzogthum Nassau, No. 15, p. 139; Jour. Prak. Chem., 83, p. 385; Chem. Centbl., 1861, p. 874; Jahresb. Chem., 1861, p. 1094), reports alumina (per cent by weight) as follows in Nassau mineral water: Soolsprudel, 0.00062; Soolsprudel (sample taken in 1859), 0.00012; No. IV (1857), 0.00054; No. VII (1858), 0.00005; No. I (1859), 0.00016; No. X (1859), 0.000023; No. III (1859), 0.00016; and Neuenhainerquelle (1860), trace.

Cassels, J. L. (Amer. Chem., 4 (1873), p. 169; Jahresb. Chem., Naumann, 1873, p. 1246), reports 0.333 gm. Al_2O_3 per 10,000 cc. in spring-water from Castalia, Ohio.

Chandler, C. F., F. A. Cairns, and **S. P. Sharpless** (Ann. Chem., 2d ser., 3, pp. 93, 164, and 202; Jahresb. Chem., Naumann, 1872, p. 1189) found in the Saratoga waters "Glacier Spouting," "Empire," and "Triton," 0.08 gm., 0.07 gm., and a trace of alumina per 10 liters.

Chandler, C. F., and **F. A. Cairns** (Amer. Chem., 4 (1873), p. 86; Jahresb. Chem., Naumann, 1873, p. 1246) note 0.055 gm. Al_2O_3 per 10 liters in Saratoga union spring-water (0.324 grains per gallon).

Chandler, C. F., and **F. A. Cairns** (Amer. Chem., 6, p. 241; Jahresb. Chem., 1876, p. 1309) report 0.1002 gm. Al_2O_3 per 10,000 cc. in St. Leon water from Canada, and (Amer. Chem., 6, p. 370; Jahresb. Chem., 1876, p. 1309) 0.0220 gm. Al_2O_3 per 10,000 cc. in artesian water from Sheboygan, Wisconsin.

Chatard, T. M. (U. S. Geol. Survey, Bul. 9, p. 23), found in water from Humboldt River, Nevada, 0.3615 gm. total solids per liter, of which 0.0013 gm. or 0.37 per cent was Al_2O_3.

Chatard, T. M. (U. S. Geol. Survey, Bul. 9, p. 24), in water from Hot Springs, Hot Springs Station, Nevada, found 2.4924 gms. total solids per liter, 0.0010 gm. or 0.04 per cent being aluminium.

Chatard, T. M. (U. S. Geological Survey, Bul. 9, p. 27), found in warm spring-water, Mono Basin, California, 2.0850 gms. total solids, containing 0.0018 gm. or 0.09 per cent Al_2O_3.

Chatard, T. M. (U. S. Geological Survey, Bul. 9, p. 29), found in water from City Creek, Utah (collected above reservoir which supplied Salt Lake City), 0.2400 gm. total solids per liter, 0.0010 gm. or 0.041 per cent being Al_2O_3.

Chatard, T. M. (U. S. Geol. Survey, Bul. 55, p. 93), found in water from Owens Lake, California, 0.023 gm. Al_2O_3 per kilo.

Chatard, T. M. (U. S. Geological Survey, Bul. 64, pp. 59, 60), notes 0.0005 and 0.0012 gm. Al_2O_3 per liter respectively in artesian wells A and B, St. Augustine, Florida; also 0.0077 gm. Al_2O_3 per liter in water from a well four miles northwest of Clinton, Miss.

Chevallier, A. (Jour. Chem. Med., 3d ser., 7, p. 193; Jahresb. Chem., 1851, p. 666), found 0.125 gm. alumina and silica per liter in mineral water from Wattweiler.

Clark (Chem. Soc. Quar. Jour., 1, p. 155; Pharm. Centbl., 1848, p. 650; Jahresb. Chem., 1847–48, p. 998) notes a trace of alumina in the Thames water at Twickenham.

Clark, F. W. (U. S. Geol. Survey, Bul. 55, p. 92; Jahresb. Chem., 1891, p. 2622), reports 0.0020 gm. Al_2O_3 per 1000 cc. in Potash Sulphur Spring water from Garland County, eight miles southeast from Hot Springs.

Cloëz, C. (Compt. Rend. Acad. Sci. Paris, 98, p. 1282; Jahresb. Chem., 1884, p. 2036), found 0.0710 gm. Al_2O_3,SiO_2 per 1000 c.c. in a mineral spring near Brucourt, in the neighborhood of Dives, France.

Crawfurd (Vierteljahressch. Prakt. Pharm., 6, p. 161; Chem. Centbl., 1875, p. 267; Jahresb. Chem., 1857, p. 722) notes 0.023421 $Al_2O_3.SiO_3$ per 1000 parts in mineral water from Kellberg near Passau, Germany.

Crook, J. K. (Mineral Waters of the United States and their Therapeutic Uses, Philadelphia, 1899), made an extensive compilation of analyses of mineral waters of the United States which was based, the author says, on treatises on mineral waters, issued by the various States, National Geological reports, railroad guides, etc., as well as information received in reply to inquiries addressed to all spring resorts and commercial springs of the United States which could be reached. Personal visits were also paid to many of the more important localities. In quoting analytical data he has expressed the results in grains per United States gallon. The whole subject is discussed with special reference to the use of mineral waters in the treatment of disease. It has been the author's purpose to include all the springs of the United States whose waters are actually used at the present time. The following statements are made regarding aluminium in discussing the value of the different constituents of mineral waters:

"This substance is found in springs in the form of the oxide, or alumina, and of the sulphate. It occurs in variable quantities, ranging from a mere trace to sixty or eighty grains per gallon, as seen in some of the Virginia alum springs. The sulphate is almost always present in the sulphureted chalybeate waters, and, as stated above, in the acid springs. The internal use of alum waters is generally governed by these associated ingredients. Some of the alum springs have acquired a considerable reputation in scrofulous diseases and in chronic diarrhœa and dysentery. The iron-alum waters are beneficial in passive hemorrhages and in exhausting night-sweats. Locally their astringent action calls them into service in much the same class of cases as are benefited by the acid waters. They have produced valuable results in conjunctivitis, stomatitis, chronic vaginitis, and other relaxed or inflammatory states of those portions of the mucous surfaces accessible to local treatment. They have also been found to act as a useful auxiliary in the treatment of ulcerated surfaces, abrasions, etc. In large quantities the alum waters have a laxative influence, but they are seldom used in virtue of this action."

The following table summarizes the data quoted from Dr. Crook's report:

ALUMINIUM IN SPRING-WATERS OF THE UNITED STATES.

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
			Grains.	Grains.
Alabama.				
Matchless Mineral Wells. . . .	E. A. Smith, J. B. Little	91	. . . .	3.65
Arkansas.				
Arkansas Lithia Springs. . . .	Muehler	98	. . . .	0.92
California.				
Agua de Vida Lower Spring.	Anderson	110	. . . .	.37
Agua de Vida Upper Spring.	Anderson	110	. . . .	.40
Alum Rock Alkaline Saline Spring.	Anderson	112	. . . .	6.45
Alum Rock Chalybeate Sp'g	Hatch	112	. . . .	.15
Anderson Iron Spring.	G. E. Colby	114	. . . .	.93
Anderson Sour Spring.	G. E. Colby	115	7.11	. . . . . .
Blodgett's Springs	Anderson	120	. . . .	4.13
Calistoga Springs.	Anderson	126	. . . .	.47
Calistoga Swimming Pool. . .	Anderson	126	. . . .	.27
El Paso de Robles, Main Sulphur Spring.	Anderson	130	. . . .	.25
El Paso de Robles, Soda Spring.	Anderson	131	. . . .	.85
Eureka Springs.	W. D. Johnson	131	. . . .	1.30
Felt's Mineral Springs.	. . . .	132	. . . .	*a*
California Geysers, Lemonade Spring	T. Price	138	32.02	
California Geysers, Witches' Caldron.	T. Price	138	2.04	.27
California Geysers, Acid Sp'g	T. Price	138	20.62	
CaliforniaGeysers,Alum Sp'g	T. Price	138	63.82	
California Geysers, Iron Geyser Creek	T. Price	138	. . . .	.89
California Geysers, Spring on hill.	T. Price	138	.20	
California Geysers, Iron Sp'g	T. Price	138	. . . .	.17
California Geysers, Indian Spring.	T. Price	138	. . . .	.18
California Geysers, Mud Indian Spring.	T. Price	138	22.78	
California Geysers, Spring little above Indian Spring	T. Price	138	118.78	
California Geysers, hot sulphur-water, above bathhouse.	T. Price	138	2.39	
California Geysers, Devil's Teakettle.	T. Price	138	31.16	
Glen Alpine Springs.	Anderson	142	. . . .	1.43
Gordon Springs.	Anderson	142	. . . .	3.55
Harbin Hot Sulphur Spring.	. . . .	144	. . . .	1.60
Harbin Chalybeate Spring. .	. . . .	144	. . . .	.73

a. Amount not stated. Qualitative analysis.

ALUMINIUM IN SPRING-WATERS.—*Continued.*

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
			Grains.	Grains.
Highland Seltzer	W. Anderson	146	....	1.75
Highland Dutch or Ems	W. Anderson	146	....	.12
Hot Borate	....	147	....	2.04
Howard Springs, Excelsior, No. 1	W. T. Wenzell	148	....	0.03
Howard Springs, The Twins, No. 2	W. T. Wenzell	148	....	0.15
Howard Springs, Eureka, No. 3	W. T. Wenzell	148	....	0.10
Howard Springs, Neptune, No. 4	W. T. Wenzell	148	....	0.19
Howard Springs, Soda, No. 5	W. T. Wenzell	148	....	0.13
Lane Mineral Springs	San Francisco Refining and Analytical Association	150	....	2.01
Litton Seltzer Springs	W. Anderson	151	....	6.81
Mark West Springs	....	152	....	*a*
Mono Lake	W. Anderson	153	....	26.63
Pagoda Spring (Napa Soda)	W. Anderson	155	....	.57
Newsom's Arroyo Grande Springs	W. Anderson	156	....	.33
Pacific Congress Springs	W. Anderson	158	....	4.50
Great Paraiso Hot Soda Springs	....	160	....	.56
Piedmont White Sulphur "Iron Springs"	W. Anderson	161	....	.45
Santa Barbara Hot Springs	W. Anderson	162	2.90	
Santa Rosa White Sulphur Springs	W. Anderson	163	....	.93
Santa Ysabel Sulphur Springs, "Main Warm"	W. Anderson	164	....	.73
Santa Ysabel Sulphur Springs, Cold Sulphur No. 1	W. Anderson	164	....	.83
Santa Ysabel Sulphur Springs, Cold Sulphur No. 2	W. Anderson	164	....	.84
Santa Ysabel Warm Sulphur Mud	W. Anderson	165	....	.65
Summit Soda Springs	W. Anderson	168	....	1.13
Thermal Acid (Caso Range)	....	169	7404.41?	
Tolenas Springs	W. Anderson	170	....	1.10
Tuscan (or Lick) Springs	F. W. Hatch	170	....	*a*
Wilbur Springs	W. Anderson	174	....	3.93
Witter's Mineral Springs	....	174	....	1.65
Young's Natural-gas Well and Mineral Springs	W. Anderson	175	....	5.18
Colorado.				
Manitou Soda Springs, Manitou	E. Waller	187	....	.07

a. Qualitative analyses. Amount not reported.

ALUMINIUM IN SPRING-WATERS.—*Continued.*

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
			Grains.	Grains.
Manitou Soda Springs, Navajo	E. Waller	187	....	.10
Poncho Hot Springs	....	190	....	5.20
Connecticut.				
Stafford Spring	L. Norton	197	....	.11
Georgia.				
Bowden Lithia Upper Spring	Pratt	206	1.33	
Bowden Lithia Lower Spring	Pratt	206	2.61	
Bowden Lithia Lower Spring	Doremus	206	.53	
Franklin Spring	....	212	*a*	
Hughes' Mineral Well	H. C. White	214	1.02	
Trentham Spring	....	218	....	*a*
Meriweather County Warm Spring	H. C. White	219	....	.46
Idaho.				
Indan-Ha Spring	C. F. Chandler	222	....	.05
Illinois.				
Kane County Magnesia Spring	W. S. Hains	226	....	.09
Indiana.				
Indian Alkaline Saline Spring	E. T. Cox	231	.82	
Magnetic Mineral Spring	W. A. Noyes	234	....	.17
Iowa.				
Fry's Mineral Spring	W. S. Hains	239	....	.06*b*
Lineville Mineral Springs	A. E. Woodward	239	....	.28
Kansas.				
Geuda Spring No. 1	Bailey	244	....	.06
Geuda Spring No. 2	Bailey	244	....	.01
Geuda Spring No. 4	Bailey	244	....	.01
Geuda Spring No. 5	Bailey	244	....	.01
Geuda Spring No. 7	Bailey	244	....	.01
Topeka Mineral Wells	Barnes and Sims	247	....	.40
Kentucky.				
Big Bone Springs	....	250	*a*	
Maine.				
Keystone Spring	R. C. Stanley	265	....	.85*c*
Maryland.				
Mardela Spring	P. B. Wilson	272	....	.34

a. Qualitative analyses. Amount not given.

b. Heinrichs, in an analysis of this water, reports .29 grains "Silica Alumina" per U. S. gallon.

c. With silica.

ALUMINIUM IN SPRING-WATERS.—*Continued.*

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
Michigan.			Grains.	Grains.
Clark's Riverside Mineral Springs	S. P. Duffield	286	....	13.41
Eastman's Springs, King David	....	286	....	.11
Eastman's Springs, Bimini	....	287	....	.03
Eastman's Springs, Golden Fountain	....	288	....	.01
Owosso Mineral Water	....	293	....	.62*a*
St. Clair Mineral Spring	S. P. Duffield	296	....	830.00
Minesota.				
Indian Medical Spring	C. W. Drew	299	....	.03
White Mineral Spring	W. A. Noyes	299	....	.14
Mississippi.				
Brown's Wells, Spring No. 1	J .R. Chilton	302	8.11	
Brown's Wells, Spring No. 2	G. Little	302	....	*b*
Castilian Mineral Spring, No. 1	E. W. Hilgard	303	*b*	
Missouri.				
B. B. Mineral Water	P. Schweitzer	309	18.31	
Blue Lick Springs	P. Schweitzer	310	....	*b*
Blue Lick Springs	....	311	....	10.23
Excelsior Springs	....	312	....	*b*
Nevada.				
Walley's Hot Springs	J. W. Phillips	325	....	.02
New Hampshire.				
Bradford Mineral Spring	Jackson, also Richards	327	....	*b*
Londonderry Lithia Spring	H. Halvorson	328	5.05	
New Mexico.				
Las Vegas Hot Spring, No. 6	W. S. Hains	334	....	.10
New York.				
Geneva Lithia Water	A. A. Cunningham	350	8.75	
Deer Lick Spring	C. F. Chandler	354	....	.34
North Carolina.				
Thompson's Bromine-arsenic Spring	H. Froehling	374	....	*c*

a With silica.

b. Amount not given. Qualitative analyses.

c. Contains .12 grain aluminium phosphate per U. S. gallon.

ALUMINIUM IN SPRING-WATERS.—*Continued.*

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
			Grains.	Grains.
North Carolina Hot Springs.	Chandler and Pellew	376	....	.04
Park's Springs............	A. R. Ledoux	378	....	3.50
Pennsylvania.				
Bedford Magnesia Spring...	V. G. Bloede	400	....	.11
Bedford Bowling Alley Spring................	V. G. Bloede	400	....	.09
Gaylord & Gulick Mineral Springs................	F. A. Genth	406	6.58*a*	
Minnequa Springs........ ..	C. M. Cresson	409	....	.12*b*
Tuscarora Lithia Spring....	W. A. Middleton?	416	....	*c*
South Dakota.				
South Dakota Hot Springs, Mammoth Mineral Spring.	C. B. Gibson?	430	....	.27
Lakatah Springs..........	C. B. Gibson?	431	....	.02
Tennessee.				
Dixie Mineral Water.......	J. W. Slocum	435	....	.30
Red Boiling Springs, No. 2..	J. T. Anderson	444	....	.12
Upper Red Boiling Spring ..	J. M. Safford and J. C. Wharton	446	.15	
Texas.				
Burdett Mineral Wells......	W. H. Johnson	449	....	*bc*
Overall Mineral Well No. 1..	E. Everhart	452	81.71	
Overall Mineral Well No. 2 .	E. Everhart	452	4.99	
Utah.				
Midway Warm Springs.	A. Meacham	460	.56	
Utah Hot Springs..........	S. F. Baird	461	....	.25
Virginia.				
Harris Antidyspeptic and Tonic Springs, No. 1.....	E. T. Fristoe	476	....	.16*b*
Blue Ridge Springs........	H. Froehling	480	....	*d*
Cold Sulphur Springs.......	....	482	2.46	
Crocket's Arsenic-Lithia Springs................	H. Froehling	485	....	*e*
Glenola (Wayland) Spring ..	M. B. Hardin	489	....	*f*
Hunter's Pulaski Alum Springs................	W. H. Taylor	497	16.40	

a. Practically the same analyses as quoted by Peale (U. S. Geological Survey Bulletin 32, page 49) for Blassburg (Pa.) springs.

b. The value given refers to aluminium.

c. Qualitative analyses. Amount not reported.

d. Contains .02 grain aluminium phosphate and .15 grain aluminium silicate per U. S. gallon.

e. Contains trace of aluminium phosphate and .12 grains aluminium silicate per U. S. gallon.

f. Contains .04 grain aluminium phosphate and .20 grain aluminium silicate per U. S. gallon.

ALUMINIUM IN SPRING-WATERS.—*Continued.*

Spring.	Analyst.	Page.	Aluminium Sulphate per U. S. Gallon.	Alumina per U. S. Gallon.
			Grains.	Grains.
Iron Lithia Springs........	H. Froehling	497	8.05	*a*
Massanetta Springs........	J. W. Mallet	499	....	0.13
Milboro Sulphur Spring.....	G. B. M. Zerr	500	*b*	.26
Roanoke Red Sulphur Chalybeate Spring...........	H. Froehling	506	.05	*c*
West Virginia.				
Hart Well................	S. C. Wells.	531	....	*d*
Wisconsin.				
Allouez Mineral Water.....	W. W. Daniels	535	....	.17
Fort Crawford Mineral Water..................	G Bode	537	....	.66
Wyoming.				
Fountain Geyser, Yellowstone National Park......	....	552	....	.96*e*

a. With .11 grain aluminium phosphate per U. S. gallon in addition.

b. With trace of aluminium phosphate in addition.

c. With .02 grain aluminium phosphate per U. S. gallon in addition.

d. Contains .03 grain aluminium phosphate and .09 grain aluminium and iron carbonate per U. S. gallon. See also analyses quoted by Peale, U. S. Geological Survey Bulletin 32, page 73.

e. Chemical combinations calculated by E. E. Smith from analytical data.

Dambergis, A. K. (Ber. Deut. Chem. Gesellsch., 20, p. 3328; in Jour. Chem. Soc. London, 54 (1888), II, p. 238), in the water of one of the sulphur springs of the peninsula of Methana on the east side of the Chelona range near the village of Wromolimni, reports 0.019 parts Al_2O_3 per 10,000.

Dambergis (Ber. Deut. Chem. Gesellsch., 19, p. 2538; Jour. Chem. Soc. London, 52 (1887), II, p. 23) reports 0.0200 alumina in water from Ægina Springs and 0.06000 in water from Andros, grams per 10,000 cc. in both cases.

Davis, R. H. (Jour. Chem. Soc. London, 39, p. 19; Jahresb. Chem., 1881, p. 1449), notes 12.78 gms. Al_2O_3 per 10,000 cc. in the Harrowgate, England, "Old Alum Well."

Darton, N. H. (U. S. Geological Survey Bul. 138), in his report on artesian well prospects on the Atlantic coastal plain region, quotes a number of analyses of water in which iron and alumina are reported together.

De Luca (Compt. Rend. Acad. Sci. Paris, 67, p. 909; Inst. 1868, p. 354; Jahresb. Chem. Will., 1868, p. 1040) reports traces of alumina in the "Solfatare" of Puzzuoli.

De Luca, S. (Compt. Rend. Acad. Sci. Paris, 70, p. 408; Jour. Pharm., 4th ser., 12, p. 33; Inst. 1870, p. 49; Chem. Centbl., 1870, p. 180; Chem. News, 21, p. 119; Jahresb. Chem., Naumann, 1870, p. 1389), reports 0.335 gm. Al_2O_3 per 1000 cc. in the "Solfatare" water from Pozzuoli.

De Negri, A. and **E.** (Gaz. Chim. Ital., 8 (1878), p. 120; Jour. Chem. Soc. London (1878), II, p. 715), note 0.000417 gm. aluminium phosphate per liter in mineral water from Casteggio, Italy.

Devarda, A. (Chem. Centbl., 1891, II, p. 365; Jahresb. Chem., 1891, p. 2619), in mineral water from Costalta (Southern Tyrol), notes 0.01614 gm. $Al_2O_3 . 3SiO_2$ per 1000 cc.

Deville (Ann. Chim. Pharm., 3d ser., 23, p. 32; Arch. Pharm., 2d ser., 55, p. 301; Jahresb. Chem., 1847–48, p. 996) analyzed a number of waters, finding alumina as follows (grams per 100,000 cc.): Seine River at Bercy, 0.0005; Rhine at Strasburg, 0.0025; Loire at Orleans, 0.0071; Rhone at Geneva, 0.0039; Doubs at Rivotte, 0.0021; Mouillère spring-water, 0.0043; Billecul Spring, 0.0043; Arcier Spring, 0.0090; Bregille Spring at Besançon, 0.0065; Suzon Spring at Dijon, 0.0010; Arcueil at Paris, 0.0053; well in the Grand Rue, 0.0094; well Rue de la Préfecture, 0.0062; and at the Faculté des Sciences at Besançon, 0.0039.

Dewar, J. (Chem. News, 24, p. 171; Jour. Chem. Soc. London, 25 (1872), p. 60), found 1.8 grains Al_2O_3 per gallon in the acidulous chalybeate water from Melrose.

Dietrich, H. (Min. Petr. Mitth., 2d ser., 3, p. 439; Jahresb. Chem., 1880, p. 1527), reports 0.005, 0.006, and 0.005 gm. Al_2O_3 per 10,000 gms., respectively, in three mineral springs at Krynica, Austria-Hungary.

Dietrich, H. (Jahrb. K. K. Geol. Reichsanst., 43 (1893), p. 275; Jour. Chem. Soc. London, 70 (1896), II, p. 435), found 0.00335 Al_2O_3 per 1000 parts in the water of the Klebelsberg Spring, Ischl, Austria.

Dormoy (Ann. Min., 6th ser., 12, p. 461; Jahrb. Chem. Will.. 1867, p. 1040) reports alumina with iron oxid or iron and manganese oxid in fourteen waters from Luxeuil, the amount ranging from 0.00157 to 0.01486 gm. per liter.

Drown, T. M. (State Board Health Mass. Rpt., 24 (1892), p. 345), reported analyses of a number of waters from Massachusetts. The data regarding alumina follow:

ALUMINIUM IN MASSACHUSETTS WATERS.

Kind of Water.	Alumina. Parts per 100,000.
Mansfield, well	0.0173
Framingham, Spring northeast of sewage fields	.0444
Stoughton, well	.0475
Everett, Spring	.0325
Malden, tubular wells	.0125
Framingham, Spring northwest of sewage field	.0250
Hyde Park, Neponset River	.0062
Hyde Park, tubular wells near river	.0440
Hyde Park, starch-factory well near river	.0175
Woburn, Horn Pond	.0409
Woburn, filter-gallery	.0143
Wayland, reservoir	.0360
Wayland, filter-gallery	.0475
Westborough, Insane Hospital tubular wells	.0250
Reading, filter-gallery	.0493
Bradford, Well No. 7	.0250
Bradford, Well No. 12	.0100
Marblehead Water Co., Swampscott, large wells and tubular wells	.0125
Marblehead, town supply, large well and tubular wells	.0110
Lawrence, sewage filtered through filter-paper	.3850
Lawrence, effluent from intermittent filtration of sewage. Tank No. 4	.0266
Lawrence, effluent from intermittent filtration of sewage. Tank No. 9	.0457

Du Mênil (Arch. Pharm., 2d ser., 69 (1852), p. 1; Pharm. Centbl., 1852, p. 229; Jahresb. Chem., 1852, p. 754) found 0.500 grain alumina (with silica) per 3 pounds in sulphur-water from Seebruch near Vlotho.

Du Ponteil (Ann. Chem. Pharm., 96, p. 193: Jour. Prakt. Chem., 67, p. 249; Chem. Centbl., 1856, p. 4; Ann. Chim. Phys., 3d ser., 46, p. 233; Jahresb. Chem., 1855, p. 831) found 0.3546 $Al_2O_3 \cdot 3SO_3$ per 100 parts in the clear yellow very acid water of a hot lake on the volcanic White Island, Plenty Bay, New Zealand.

Eakins, L. G. (U. S. Geol. Survey Bul. 60, p. 172), found in water from a 1000-foot well in Lebanon, Missouri, 0.0032 gm. Al_2O_3 per liter.

Effenberger, A. (Wiener Akad. Ber. 51, 2. Abt., p. 252; Chem. Centbl., 1865, p. 848; Jahresber. Chem. Will., 1865, p. 934), notes per 10,000 parts, 0.006 part alumina in the medicinal springs at Müllaken in Upper Austria.

Egger, E. (Chem. Centbl., 1881, p. 664; Jahresb. Chem., 1881, p. 1443), reports an analysis of the Adelheidquelle at Heilbrunn, Germany. This water contained 0.0010 gm. Al_2O_3 per 1000 cc.

Egger, E. (Chem. Centbl., 1882, p. 187; Jahresb. Chem., 1882, p. 1629), in a sulphur spring at Seon, Germany, reports 0.0018 gm. aluminium phosphate per 1000 cc.

Emerson, B. K. (U. S. Geol. Survey Mon. 29, p. 750), quotes an analysis made by S. D. Hayes of the water of Mount Mineral Spring, Shutesbury, Massachusetts. A trace of alumina is reported.

Emerson, B. K. (U. S. Geol. Survey Bul. 159, p. 91), reports 12.80 Al_2O_3 parts per 1,000,000 in water from an artesian well in Dalton, Massachusetts.

Emmons, S. F. (U. S. Geol. Survey Rpt., 17 (1895–96), pt. II, p. 411), in an article on the mines of Custer County, Colorado, reports a number of analyses by Hillebrant. Vadose water from the Geyser mine, 500-foot level, contained 0.8 $Al_2O_3 \cdot P_2O_5$ parts per 1,000,000 (p. 461); deep water from the Geyser mine, 2000-foot level, 1.06 Al_2O_3 parts per 1,000,000 (p. 462). These values refer to the theoretical composition of the water before sediment was deposited.

Essner, J. C. (Bul. Soc. Chim., 3d ser., 6, p. 148; Jahresb. Chem., 1891, p. 2615), reports 0.240 gm. aluminium sulphate ($+18H_2O$) per 1000 cc. in a subterranean water from the neighborhood of Port Vendres.

Essner, J. C. (Bul. Soc. Chim., 3d ser., 7, p. 480; Jahresb. Chem., 1892, p. 2688), reports 0.0240 gm. (?) Al_2O_3 per 1000 cc. in water from the iron sulphur spring at Roufaque.

Fehling (Württemberg. Naturwissensch. Jahreshefte, 13, p. 113, Jahresb. Chem., 1857, p. 720) found traces of alumina in the following artesian mineral water from the Stuttgart bath near Berg: Haupt-Trinkquelle and Westliche Quelle.

Fehling (Württemberg. Naturw. Jahreshefte, 16, pp. 106, 129; Neues Jahrb. Pharm., 14, pp. 286, 295; Jahresb. Chem., 1860, pp. 833, 834) reports alumina as follows (grams per 100,000) in Württemberg mineral waters: Wildbad Warm Springs; Trinkquelle No. 10, Trinkhalle, 0.055; Quelle No. 19, Katherienbad, 0.059; mixture of water from ten springs, 0.070; Teinach mineral springs, Hirschquelle, 0.126; Bachquelle, trace; and Dintenquelle, 0.071.

Fehling, H. (Württemb. Naturw. Jahresb., 22, pp. 129, 147, 159; Jahresb. Chem. Will., 1867, p. 1035), notes an average of 0.055 parts of alumina per 100,000 in waters from Wildbad; 0.038 in water from Liebenzell; traces in Bachquelle from Teinach, and 0.126 in Hirschquelle from Teinach.

Feliciani, G. (Gaz. Chim. Ital., 26 (1896), I, p. 281; Jour. Chem. Soc. London, 70 (1896), II, p. 615), notes a trace of alumina in the water of the acid spring at Ponte Molle near Rome.

Fellenberg reports (Untersuchung d. Schwefelwasser d. Gurnigelbades, Bern, 1849; Jahresber. Chem. Will., 1850, p. 623) 0.0051 part aluminium silicate per 10,000 gms. in one water analyzed, designated No. A. Further, 0.08 alumina and iron oxid in another, designated No. B. The author also analyzed the water from two other sulphur springs from the same neighborhood. No aluminium was reported in either. In the sediment of the Stockquelle (l. c., p. 624) he found 14.47 per cent alumina (with calcium phosphate). The Stockquelle water was one of those mentioned which contained no alumina.

Ferstl (Jahrb. K. K. Geol. Reichsanstalt, 1853, No. 4, p. 683; Jahresb. Chem., 1853, p. 712) reports in the Luhatschowitz (Austria) mineral water, Vincenzbrunnen, Amandbrunnen, Johannisbrunnen, and Luisenquelle, aluminium phosphate (parts per 1000) as follows: 0.0047, 0.0048, 0.0041, and 0.0086, respectively.

Figuier and **Mialhe** (Jour. Pharm., 3d ser., 13, p. 401; Jour. Chim. Med., 3d ser., 4, p. 635; Pharm. Centbl., 1848, p. 662; Jahresb. Chem., 1847–48, p. 1005) note a trace of alumina in Niederbronn (Alsace) and alumina (grams per 1000 cc.)

as follows in mineral water from Bourbonne: Source de la Place, 0.030; Source de l'intérieur de l'établissement, 0.029. They also note (Jour. Pharm., 3d ser., 11, p. 338; Jour. Prakt. Chem., 42, p. 465; Pharm. Centbl., 1847, p. 431; Jahresb. Chem., 1847–48, p. 1006) a trace of aluminium in mineral water from Rieumajou near Salvétat, Dept. de l'Hérault.

Filhol (Jour. Pharm., 3d ser., 20, p. 81; Jahresb. Chem., 1851, p. 664) reports aluminium silicate (gms. per 1000 cc.) in Bagnères-de-Luchon springs as follows: Bayen, a trace; Azémar, 0.0237; Richard (upper spring), 0.0292; Grotte supérieure, 0.0109; Blanche, 0.0101; Ferras (upper spring No. 2), trace; Pré No. 1 and Bordeu No. 4, each 0.0073; Grotte inférieure, 0.0141, and La Reine, 0.0274. Ferras also contained 0.0022 gm. alumina per 1000 cc., and La Reine a trace.

Filippuzzi (Wiener. Acad. Ber. 21, p. 561; Chem. Centbl., 1856, p. 937; Jahresb. Chem., 1856, p. 773) reports 0.01927 aluminium phosphate and 0.36004 aluminium sulphate per 10,000 parts in mineral water from Valdagno, Italy.

Finckh, C. (Neue. Jahrb. Pharm., 34, p. 13; Chem. Centbl., 1870, p. 615; Jahresb. Chem. Naumann, 1870, p. 1382), notes traces of aluminium in Ochsenhausen mineral water from Bieberach, Germany.

Flückiger, F. A. (Mittheil. Naturf. Gesellsch. Bern, 1862, p. 17; Arch. Pharm., 2d ser., 111 (1862), p. 111; Vierteljahressch. Prakt. Pharm., 11, p. 342; Jahresb. Chem., 1862, p. 820), analyzed a sample of acid water taken by Stöhr and Zollinger in 1858 at the first waterfall of the brook Sungi Paït flowing from the lake in the crater of Idjen volcano in Java. It contained per 100 gms. 0.150 Al_2O_3.

Folberth (Verhandl. und Mittheil. Siebenbürg. Vereins Naturwissensch., 1855, No. 7; Jahresb. Chem., 1855, p. 844) reports 0.0222 basic aluminium phosphate per 1000 parts in the saline water from the Felsenquelle near Bassen, Hungary.

Folberth, F. (Verhandl. u. Mittheil. Siebenbürg. Vereins Naturw. Hermannstadt, 11, p. 78; Jahresb. Chem., 1861, p. 1102), notes Al_2O_3 (grams per 10,000) as follows in mineral water: Pokolsár, 0.142, and Czifra-víz, 0.402.

Fresenius (Untersuchungen d. Mineralwasser d. Herzogthums Nassau, I, Wiesbaden, 1850; Jahresb. Chem., 1850,

p. 622) notes 0.0051 gm. aluminium silicate per 10,000 gms. in the Wiesbaden Kochbrunnen water.

Fresenius (Jahrb. Vereins. Naturk. Herzogthum Nassau, 7, pt. p. 145; Untersuchungen der Mineralwasser des Herzogthums Nassau, II, Wiesbaden, 1851; see also Ann. Chem. Pharm., 82, p. 249; Jahresb. Chem., 1851, p. 652) examined the mineral waters of Ems, reporting per 1000 parts aluminium phosphate as follows: Kesselbrunnen, 0.00125 part; Krähnchen, 0.00042 part; Fürstenbrunnen, 0.00044 part; Neue Quelle, 0.00142 part.

Fresenius (Chem. Unters. Mineralwasser. Herzogth. Nassau, III, Ann. Chem. Pharm., 83, p. 252; Pharm. Centbl., 1853, p. 45; Jahresb. Chem., 1852, p. 753) notes a trace of alumina in the warmest Schlangenbad mineral water.

Fresenius (Jour. Prakt. Chem., 58, p. 156; Arch. Pharm., 2d ser., 75, p. 301; Pharm. Centbl., 1853, p. 405; Jahresb. Chem., 1853, p. 709) in the Bernhard spring and the Johann-Georgen spring at Krankenheil-Tölz, Bavaria, found 0.002034 and 0.002782 gm. aluminium silicate per 1000 gms. respectively.

Fresenius (Jahrb. Ver. Naturk. Herzogthums Nassau, No. 11; Jour. Prakt. Chem., 70, p. 1; Neue. Jahrb. Pharm., 7, p. 7; Chem. Centbl., 1857, p. 49; Jahresb. Chem., 1856, p. 770) found 0.000133 gm. aluminium phosphate per 1000 gms. in water from the sulphur spring at Weilbach, Nassau, Germany.

Fresenius (Jour. Prakt. Chem., 72, p. 1; Chem. Centbl., 1857, p. 913; Jahresb. Chem., 1857, p. 720) notes a trace of alumina in the mineral spring at Geilnau in Nassau, Germany.

Fresenius, R. (Jour. Prakt. Chem., 98, p. 321; Jahresb. Chem. Will., 1866, p. 989), reports 0.000254 aluminium phosphate per 1000 parts in the potable spring-water (Trinkquelle) of Driburg and 0.000335 aluminium phosphate in the Herster mineral spring near the same place.

Fresenius, R. (Jour. Prakt. Chem., 95, p. 151; Chem. Centbl., 1865, p. 728; Vierteljahresschr. Prakt. Pharm., 15, p. 208; Jahresber. Chem. Will., 1865, p. 929), notes aluminium phosphate per 1000 parts in three springs at Pyrmont as follows: Stahlbrunnen, 0.000084; Brodelbrunnen, 0.000295; and Klosteralleequelle, 0.000091. The water of the first is used for drinking, the second for bathing.

Fresenius, R. (Jour. Prakt. Chem., 97, p. 1; Chem. Centbl., 1866, p. 335; Jahresb. Chem. Will., 1866, p. 990), reports 0.000102 part aluminium phosphate per 1000 in Felsenquelle No. 2 at Ems (Bad Ems).

Fresenius, R. (Jahrb. nassau. Verein Naturkunde, pt. 19, 20 (1864), pp. 453, 488; Jour. Prakt. Chem., 103, pp. 321, 425; Chem. Centbl., 1868, pp. 703, 800; Jahrb. Min., 1868, p. 629; Jahrb. Chem. Will., 1867, p. 1034), reports 0.000430 aluminium phosphate per 1000 parts in a mineral water from Niederselters.

Fresenius, R. (Jour. Prakt. Chem., 106, pp. 193, 206; Chem. News, 20, p. 213; Jahresb. Chem. Will., 1869, p. 1281), found in Tönnisteiner Heilbrunnen, Tönnisteiner Stahlbrunnen, and Lamscheider Mineralbrunnen, 0.00013, 0.00045, and 0.000460 part $Al_2O_3P_2O_5$ per 1000 respectively. In the latter 0.000034 part alumina united with silica is also reported.

Fresenius, R. (Jahrbücher nassau. Ver. Naturkunde, 25 and 26, pp. 347, 361; Jahresb. Chem., 1871, p. 1226), notes 0.000134 part aluminium phosphate per 1000 in Victoria and 0.000120 part in Römerquelle water from Ems.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 9, p. 368; Jour. Chem. Soc. London, 27 (1874), p. 968), notes 0.000193 part aluminium phosphate per 1000 in water from the warm mineral spring in the bath-house of the Royal William Medical Establishment at Wiesbaden.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 6, p. 53; Jahresb. Chem. Naumann, 1872, p. 1181), reports new analyses of the mineral springs at Ems. These were Kränchen, Fürstenbrunnen, Kesselbrunnen, and Neue Badequelle. They contained respectively, per 1000 parts, 0.000116, 0.000117, 0.000200, and 0.000209 part aluminium phosphate.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 7, p. 191; Jahresb. Chem. Naumann, 1873, p. 1238), notes 0.000021 part aluminium phosphate per 1000 parts in Carlsquelle water from Bad Helmstedt.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 9, p. 368; Jahresb. Chem., 1874, p. 1325), reports 0.000193 part aluminium phosphate per 1000 parts in the mineral water of Wilhelmsheilanstalt, Wiesbaden.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 25, p. 310; Jahresb. Chem., 1882, p. 1628; Jour. Chem. Soc. London, 40 (1882), p. 1178), notes traces of aluminium in the Oberbrunnen at Salzbrunn, Germany. In this same water Valentiner in 1866 noted 0.0005 gm. alumina and phosphoric acid per 1000.

Fresenius, R. (Jour. Prakt. Chem., 2d ser., 45, p. 287; Jahresb. Chem., 1892, p. 2684; Jour. Chem. Soc. London, 62 (1892), p. 796), reports per 1000 gms. in Julianenbrunnen and Georgenbrunnen water from Bad Eilsen 0.000126 and 0.000136 alumina respectively, in addition to 0.000155 and 0.000060 aluminium phosphate.

Fresenius, C. R. (Jahrb. nassau. Ver., 46 (1893), p. 1; Jour. Chem. Soc. London, 70 (1896), II, p. 315), notes a trace of alumina in the water of the Victoria Spring at Oberlahnstein.

Fresenius, H. (Jour. Prakt. Chem., 2d ser., 35, p. 237; Jahresb. Chem., 1887, p. 2532), found 0.000334 gm. aluminium phosphate and 0.000401 gm. aluminium silicate per 1000 gms. Schützenhofquelle water, Wiesbaden, Germany.

Fresenius, H. (Jahrb. nassau. Ver. Naturk., 51 (1898), p. 1; abs. Jour. Chem. Soc. London, 76 (1899), II, p. 114), finds in water from a new boring at Selters near Weilburg on the Lahn a trace of alumina.

Garrigau (Compt. Rend. Acad. Sci. Paris, 84, p. 963; Jahresb. Chem., 1877, p. 1387) notes 0.0096 part Al_2O_3 per 1000 in the Cliff Spring at Saint-Nectaire le Haut, France.

Genth (Keller and Tiedemann's Nord. Amer. Monatsber., 1852, June, p. 246; Pharm. Centbl., 1852, p. 588; Jahresb. Chem., 1852, p. 758) notes a trace of alumina in mineral water from Bristol near Philadelphia, Pennsylvania.

Giles (Pharm. Jour. Trans., 7, p. 75; Jahresb. Chem., 1847–48, p. 998) notes 0.260 gm. alumina per 10,000 gms. in springwater from Wolverton.

Gintl, W. F. (Jour. Prakt. Pharm., 2d ser., 20, p. 356; Jahresb. Chem., 1879, p. 1264), in Ferdinand Spring, Marienbad, Bohemia, reports 0.06334 gm. basic aluminium phosphate per 10,000 gms.

Gintl, W. F. (Jour. Prakt. Chem., 2d ser., 24, p. 25; Jahresb. Chem., 1881, p. 1445), notes 0.05256 $Al_2P_2O_8$ per 10,000 parts in Ambrosius water from Marienbad, Bohemia.

Gintl, W. F. (Separate; abstracted in Jahresb. Chem., 1882, p. 1632), notes 0.0744 part basic aluminium phosphate in the West spring and 0.1019 part in the East spring at Langenbruck near Franzensbad, Austria-Hungary.

Girardin (Jour. Chim. Med., 3d ser., 4, p. 643; Jour. Pharm., 3d ser., 15, p. 113; Jahresb. Chem., 1847–48, p. 1006) found a trace of aluminium sulphate in St. Paul spring-water from Rouen.

Glasel, E. (Jahrb. Geol. Reichsanst., 19, p. 295; Chem. News, 20, p. 190; Jahresb. Chem. Will., 1869, p. 1290), reports 0.0028 gm. aluminium per 1000 in mineral water from Rajec-Töplitz.

Gläser, M., and **W. Kalmann** (Ber. Deutsch. Chem. Gesellsch., 21 (1637); Jour. Chem. Soc. London, 54 (1888), p. 796), in the Roncegno (South Tyrol) water, report 0.4343 gm. Al_2O_3 per liter.

Godeffroy, R. (Sep. from Ztschr. Allgm. Oesterr. Apothekervereins; Jahresb. Chem., 1882, p. 1623), found in water from the middle of Gmünden Lake 0.100 part Al_2O_3 per 100,000.

Gooch, F. A., and **J. E. Whitfield** (U. S. Geol. Survey Bul. 47, pp. 36–81, and table facing page 82) report, in analyses of waters of the Yellowstone National Park, the following, the quantities in every case being grams per kilogram of water. In every case the author gives the calculated amount of the aluminium compound present, as well as the amount of alumina determined:

Cleopatra Spring, 0.0049 Fe.Al calculated = 0.0093 Al_2O_3; Hot River, 0.0051 Fe.Al = 0.0097 Al_2O_3; Gardiner River, sample taken Oct. 12, 1883, above Hot River, 0.0042 Fe.Al = 0.0079 Al_2O_3; Gardiner River, sample taken Sept. 26, 1884, at Mammoth Hot Springs, 0.0010 Fe.Al = 0.0019 Al_2O_3; Water-supply at Mammoth Hot Springs, 0.0011 Fe.Al = 0.0021 Al_2O_3; Soda Spring, 0.0004 Al = 0.0008 Al_2O_3; Fearless Geyser, 0.0002 Al = 0.0004 Al_2O_3; Pearl Geyser, 0.0031 Al = 0.0059 Al_2O_3; Constant Geyser, 0.0048 = 0.0304 $Al_2(SO_4)_3$; Coral Spring, sample taken Aug. 20, 1884, 0.0029 Al = 0.0143 Al_2Cl_6; Coral Spring, sample taken Oct. 11, 1886, 0.0077 Al = 0.0139 Al_2O_3; Echinus Spring, 0.0027 Al = 0.0171 $Al_2(SO_4)_3$; Schlammkessel, 0.0081 Fe.Al = 0.0513 $Al_2(SO_4)_3.Fe_2(SO_4)_3$; Fountain Geyser, 0.0057 Al = 0.0108 Al_2O_3; Great Fountain Geyser, 0.0021 Al = 0.0040 Al_2O_3; Hygeia Spring, 0.0036 Al = 0.0068 Al_3O_3; Firehole River, 0.0031 Al = 0.0059 Al_2O_3; Excelsior Geyser, 0.0012 Al = 0.0023 Al_2O_3; Old Faithful Geyser, 0.0009 Al = 0.0017 Al_2O_3; Splendid Geyser, sample taken Sept. 10, 1885, 0.0027 Al = 0.0051 Al_2O_3; Splendid Geyser, sample taken Aug. 28, 1884, 0.0034 Al = 0.0064 Al_2O_3; Giantess Geyser, 0.0049 Al = 0.0093 Al_2O_3; Beehive Geyser, 0.0029 Al = 0.0055 Al_2O_3; Grotto Geyser, 0.0036 Al = 0.0068 Al_2O_3; Turban and Grand Geysers, 0.0032 Al = 0.0061 Al_2O_3; Artemisia Geyser, 0.0079 Al = 0.0150 Al_2O_3; Taurus Geyser, 0.0040 Al = 0.0075 Al_2O_3; Asta Spring, 0.0059 Fe.Al = 0.0112 Al_2O_3; Bench Spring, 0.0145 Fe.Al = 0.0066 $Al_2(SO_4)_3$ + 0.0263 Al_2O_3; Firehole River, 0.0029 Al = 0.0055 Al_2O_3; Yellowstone Lake, 0.0021 Al = 0.0040 Al_2O_3; Alum Creek, 0.0025 Al = 0.0158 $Al_2(SO_4)_3$; Chrome Spring, 0.0043 Fe.Al = 0.0082 Al_2O_3; Mush Pot Spring, 0.0045 Al = 0.0285 $Al_2(SO_4)_3$; Devil's Ink Pot, 0.0037 Al = 0.0234 $Al_2(SO_4)_3$; Soda Butte Spring, 0.0069 Fe.Al = 0.0131 Al_2O_3.

Gorup-Besanez (Ann. Chem. Pharm., 79, p. 50; Pharm. Centbl., 1851, p. 718; Jahresb. Chem., 1851, p. 653) found alumina (unweighable amount) in mineral water from Stebin, Bavaria.

Gossart (Jour. Pharm., 4th ser., 11, p. 292; Chem. News, 21, p. 214; Jahresb. Chem. Naumann, 1870, p. 1389) notes traces of Al_2O_3 in a sulphur spring near Meurchin, Pas-de-Calais.

Göttl (Oester. Ztschr. Pharm., 1853, pp. 253, 266; Jahresb. Chem., 1853, p. 711) found 0.0040 gm. alumina per 1000 gms. in the Karlsbad Schlossbrunnen.

Göttl (Vierteljahressch. Prakt. Pharm., 4, p. 192; Arch. Pharm., 2d ser., 84, p. 179; Pharm. Centbl., 1855, p. 286; Jahresb. Chem., 1855, p. 841) notes 0.022 alumina per 10,000 parts in Giesshübler water from the Rodisfort (Germany) acid spring.

Göttl (Vierteljahressch. Prakt. Pharm., 5, p. 161; Jahresb. Chem., 1856, p. 772) notes 0.028 alumina per 1000 parts in the Karlsbad Sprudel water.

Gottlieb (Wiener. Acad. Ber., 30, p. 191; Chem. Centbl., 1858, p. 612; Jahresb. Chem., 1858, p. 796) notes 0.019 basic aluminium phosphate per 10,000 parts in Marienbrunnen water from Gabernegg, Austria-Hungary.

Gottlieb (Wiener. Akad. Ber., 56, 2. Abt., p. 836; Jour. Prakt. Chem., 102, p. 472; Jahresb. Chem. Will., 1867, p. 1038) reports 0.0147 aluminium phosphate per 10,000 parts in water from Emmaquelle at Gliechenberg in Steiermark.

Gottlieb, J. (Wiener. Akad. Ber., 60, 2. Abt., pp. 349, 357; Jahresb. Chem. Will., 1869, p. 1287), found in "old" and "new" Johannes water, and Hauptquelle from Neuhaus (all in Steiermark), 0.0233, 0.0481, and 0.0026 part aluminium phosphate per 10,000 respectively.

Gottlieb, J. (Wiener Akad. Ber., 62 2. Abt., p. 780; Jahresb. Chem. Naumann, 1870, p. 1386), notes in the Königsbrunnen from Kostreinitz in Steiermark 0.0213 part aluminium phosphate per 10,000.

Graham, T., W. A. Miller, and **A. W. Hofmann** (Rpt. Govt. Commission on the Chemical Quality of the Supply of Water to the Metropolis, London, 1851; Quart Jour. Chem. Soc., 4, p. 375; Jahresb. Chem., 1851, p. 656) note traces of alumina in water supplied by New River Water Co., East London Water Co., Kent Water Co., and Hampstead Water Co. In the second the alumina reported equals 0.47 grains per gallon with iron and phosphoric acid salts. The waters were not from the Thames. Thames water and five spring-waters from the Hindhead (Surrey) district, Farnham and Gravesend, were also found to contain alumina with iron and phosphate.

Grandeau, L. (Ann. Chim. Phys., 3d ser., 60, p. 479; Jahresb. Chem., 1860, p. 839), reports 0.0408 alumina per 1000 cc. in mineral water from Pont-a-Mousson, Dept. Meurthe, France.

Grange (Ann. Chim. Phys., 3d ser., 24, p. 496; Jahresb. Chem., 1847–48, p. 996) reports in the Isère water at Grenoble 0.0035 gm. alumina per 100,000 cc.

Grange (Jahresber. Chem., 1850, p. 622) studied the water of the Isèrethal. He regarded the earthy taste of some spring-water as due to alumina held in solution by CO_2.

Griffin, M. L. (unpublished data), found 0.718 gm. aluminium sulphate per liter in water from a spring running through the new engine-pit of the Boston and Maine Car-shops in Mechanicsville, New York.

von Gümbel, C. W. (Chem. Centbl., 1891, II, p. 566; Jahresb.

Chem., 1891, p. 2618), notes analyses by A. Schwager of Plinius-quelle and Ostgothenquelle thermal water from Bormio and the Ortler region. The former contained 0.0137 gm. Al_2O_3 per 1000 cc.; the latter 0.0042 gm.

Günsberg, R. (Wiener. Acad. Ber., 43, 2. Abt., p. 197; Jahresb. Chem., 1861, p. 1103), reports 0.0012 gm. aluminium phosphate per 1000 gms. in Siegwasser from the Bronislaw spring at Truskawice, Galicia.

Guyot, P. (Compt. Rend. Acad. Sci. Paris, 77, p. 1384; Jahresb. Chem. Naumann, 1873, p. 1242), notes 0.010 gm. $SiO_2.Al_2O_3$ per liter in Saint-Thiebaut water from Nancy.

Hamberg, N. P. (Jour. Prakt. Chem., 80, p. 385: Chem. Centbl., 1860, p. 955; Ztschr. Ges. Naturw., 17, p. 71; Jahresb. Chem., 1860, p. 842), reports aluminium sulphate (parts per 10,000) in the water of medicinal springs at Ronneby, Sweden, as follows: Eckholzquelle, 15.038230, and Alte Quelle, 3.834603.

Hardin, M. B. (Amer. Chemist, 4, p. 247, Arch. Pharm., 3d ser., 5 (1874), p. 180; Jahresb. Chem., 1874, p.1336), made analyses of four alum springs in Rockbridge County, Virginia, and reports 5.35961, 7.30856, 7.53946, 12.41395, and 3.25892 gms. alumina per 1000 cc. The water was collected under different conditions as regards rainfall. The residue obtained by evaporating the water contained 9.490 per cent alumina.

von Hauer (Jahrb. K. K. Geol. Reichsanstalt, 1853, p. 154; Jahrsb. Chem., 1853, p. 712) found in mineral water from Roggendorff, Hungary, 0.033 parts aluminium sulphate per 1000 parts.

von Hauer (Jahrb. K. K. Geol. Reichsanstalt, 1858, p. 165; Jahresb. Chem., 1858, p. 798) notes 0.0013 alumina per 1000 parts in the thermal sulphur-water from Warasdin-Töplitz, Croatia.

von Hauer (Jahrb. K. K. Geol. Reichsanstalt, 1861, p. 57: Jahresb. Chem., 1861, p. 1100) notes 0.023 grains alumina per pound (=7680 grains) in acid water from Suliguli near Visco in Marmarosch.

Hehner, O. (Chem. News, 38, p. 249; Jahresb. Chem., 1878. p. 1314), in brown water from a spring 32 kilometers from Cape Town notes 525.19 parts $Al_2S_3O_{12}$ per 100,000.

Heller, F. (Wiener. Acad. Ber., 19, p. 363; Jahresb. Chem., 1856, p. 772), notes 0.030 alumina per 10,000 parts in water from the Franz Joseph Quelle at Füred on the Plattensee.

Henry (Jour. Pharm., 3d ser., 13, p. 5; Pharm. Centbl., 1848, p. 264; Jahresb. Chem., 1847–48, p. 1007) reports aluminium silicate (grams per 1000 cc.) as follows: in Source Grande Grille, 0.230; Source nouvelle, 0.233; Source Prè Salé, 0.070 (Vichy); Source de l'Hôpital, 0.120, and Source du Puits at Cusset, 0.080.

Henry, O. (Jour. Chim. Med., 3d ser., 6, p. 314; Jahresb. Chem., 1850, p. 628), notes 0.368 parts alumina per 1000 parts in the Fraysse mineral water from Cransac, Dept. Aveyron. Poumerède (Jahresb. Chem., 1850, p. 628) found in the same water 0.369 part alumina per 1000 parts. Henry (Jour. Pharm., 3d ser., 17, p. 161; Jahresb. Chem., 1850, p. 628) also notes aluminium sulphate and aluminium ammonium sulphate in Source-haute (Richard) and Source-basse (Richard) mineral water from Cransac.

Henry, O. (Jour. Pharm., 3d ser., 19, p. 104; Jahresb. Chem., 1851, p. 663), notes aluminium silicate and lithium silicate in mineral water from Sail-lès Chateaumorand as follows: Hamel or Saule, d'Urfé, Roman, Sulphur and Iron Sulphur springs: also alumina with calcium sulphate and silica in the Bellety (steel) spring from the same place.

Henry, O. (Jour. Pharm., 3d ser., 20, p. 161; Pharm. Centbl., 1851, p. 748; Jahresb. Chem., 1851, p.664), reports alumina and silica (parts per 1000) as follows: in spring-water from Saint-Denis near Blois, Dept. Loire and Cher, Medicis, 0.007; Renaulme, 0.007; and Saint-Denis, 0.044.

Henry, O. (Jour. Pharm., 3d ser., 21, p. 401; Jahresb. Chem., 1852, p. 757), in mineral water from Saint-Honoré, Dept. Nièvre, notes 0.023 part aluminium silicate per 1000 parts.

Henry, O. (Jour. Pharm., 3d ser., 30, pp. 172, 246; Jahresb. Chem., 1856, p. 774), reports 0.050 gm. alumina and silica per 1000 cc. in mineral water from Saxon, Canton Wallis, Switzerland.

Henry, O., Sr. according to Grasset (Compt. Rend. Acad. Sci. Paris, 46, p. 182; Inst., 1858, p. 37; Jahresb. Chem., 1858. p. 802), found 0.128 gm. alumina and silica per 1000 cc. in water from Bondonneau, Dept. Drôme, France.

Henry, O., and **L'Héritier** (Jour. Pharm., 3d ser., 28, pp. 333, 408; Jahresb. Chem., 1855, p. 834) found alumina (grams per 1000 cc.) in mineral water from Plombières as follows: Source du Crucifix, 0.0120; Sources des Dames, 0.0100; Source de Sainte-Catherine, 0.0110; Bain Romain, 0.0130; Bain tempère, 0.0110; Source du Savonneuse, 0.01400; and Source ferrugineuse de Bourdeille, 0.00750.

Hessert, J. (Ann. Chem., 176, p. 241; Neue. Repert. Pharm., 24, p. 541 (see under J. Volhard): Jahresb. Chem., 1875, p. 1302), reports 0.0024 part alumina per 1000 parts in sulphur-water from Spring Bir Keraui, after removal of the sediment which separated on standing. Including sediment there was 0.0236 alumina.

Hidegh, C. (Wiener Akad. Ber., 53 (2. Abt.), p. 395; Jahresb. Chem. Will., 1866, p. 993), reports in the spring at Johannisbad near Vienna 0.008 part alumina (and P_2O_5) per 10,000 parts.

Hillebrand, W. F. (U. S. Geol. Survey Bul. 113, p. 50), found 2.5 parts $Al_2(SO_4)_3$ per 1,000,000 in East Spring, and 3.2 in West Spring at Joplin, Missouri, both zinc-bearing springs.

Hillebrand, W. F. (U. S. Geol. Survey Bul. 113, p. 114), found in water from Ojo Caliente, a thermal spring near Taos, N. M., 0.5 part Al_2O_3 per million parts.

Hoffmann, J. (Analysen der beiden Bohrquellen zu Homburg, Homburg, 1856; Neue Jahrb. Pharm., 7, p. 52; Chem. Centbl., 1856, p. 821; Jahresb. Chem., 1856, p. 770), notes traces of alumina in the water from two bored wells at Homburg, Germany.

Hruschauer (Ann. Chem. Pharm., 63, p. 229; Jour. Prakt. Pharm., 42, p. 466; Pharm. Centbl., 1847, p. 829; Jour. Pharm., 3d ser., 13, p. 49; Jahresb. Chem., 1847–48, p. 1002) reports 0.163 gm. basic aluminium phosphate per 10,000 gms. in Kostreiniz (Steiermark) mineral water.

Hübener (Chem. Ztg., 14, p. 1410; Chem. Centbl., 1890. II, p. 846) notes 0.002500 gm. alumina (with a trace of phosphoric acid per liter in water from a bored well in Westerland.

The well from which this water was obtained had been recently bored. The water contained a much larger proportion of iron than many of the longer-known steel-wells. Westerland is on the Island of Sylt, Prussia.

Huppert (Chem. Centbl., 1877, p. 137; Jour. Chem. Soc. London, 1878, II, p. 209) reported analyses of the water of the new spring and Josefsquelle at Bilin; they contained respectively 0.0056, and 0.0057 $Al_2O_3.P_2O_5$, presumably parts per 10,000. He quotes an analysis of the Josefsquelle water made in 1845 by Redtenbacher, reporting 0.084 $Al_2O_3.P_2O_5$.

Hunt, T. S. (Silliman's Amer. Jour., 2d ser., 8, p. 364; Jahresb. Chem., 1849, p. 621), reports 0.4681 part alumina per 1000 parts in Tuscarora Sour spring-water from the neighborhood of Brantford, Canada.

Hunt, T. S. (Silliman's Amer. Jour., 2d ser., 11, p. 174; Jahresb. Chem., 1851, p. 669), reports a trace of alumina and phosphate in water from the "outer spring" at Varennes; a trace of alumina in the "inner spring" water from Varennes; 0.014500 part alumina per 1000 parts in St. Leon and 0.00500 in Caxton water; all mineral springs in Canada.

Hunt, T. S. (Phil. Mag., 4th ser., 13, p. 239; Chem. Centbl., 1857, p. 683; Jahresb. Chem., 1857, p. 728), found a trace of alumina in Ottawa River water taken at St. Anne Lock, near Montreal, and St. Lawrence River water, taken on the south side of the Pointe-des-Cascades near Vaudreuil.

Husemann, A. (Neue Jahrb. Pharm., 33, p. 197; Chem. Centbl., 1870, p. 392; Amer. Chemist, 2d ser., 1, p. 119; Jahresb. Chem., Naumann, 1870, p. 1383), notes traces of aluminium in the Belvedra Spring near Chur.

Husemann, A. (Neue Jahrb. Pharm., 38, p. 257; Jahresb. Chem., Naumann, 1872, p. 1184), reports 0.0022, 0.0021, 0.0018, and 0.0018 part alumina per 10,000 parts in four samples of mineral water from Tarasp.

Husemann, A. (Jahrb. Pharm., 39, p. 200, 315; Jahresb. Chem., Naumann, 1873, p. 1240), reports 0.0011 part alumina per 10,000 parts in Neue Belvedraquelle, and traces in three other springs, all near Chur, Switzerland.

Husemann, A. (Arch. Pharm., 3d ser., 6, pp. 97, 395; 7, p. 204; Jahresb. Chem., 1875, p. 1291), reports respectively in the "old" and "new" St. Moritz (Switzerland) Eisen Säuerling, 0.00050 and 0.00030 part alumina per 10,000 parts. Three Tarasp (Lower Engadine) mineral springs contained per 10,000 parts respectively 0.0025, 0.0019, and 0.0021 part alumina.

Two Val Sinestra springs (Lower Engadine) contained per 10,000 parts respectively 0.0020 and 0.0021 part alumina.

Jackson, D. D., says in unpublished data regarding the natural occurrence of aluminium sulphate in waters: "Many of our driven wells along the southern shore of Long Island contain aluminium sulphate, but in no case does an entire well-plant contain it.

"Alum is noticeable in amount in individual wells at Oconee, Clear Stream, Wantagh, Merrick, and Matowa. One of the wells recently analyzed at Merrick contained 268 parts per million of aluminium sulphate. This is equivalent to 15.6 grains per gallon. In other words, the water would remove the color and impurities from fifteen to twenty times its volume of impure water.

"This analysis was made after the water had been actively drawn upon for two weeks, and at this time the taste was strong of alum. During periods of rest the alum is considerably greater in amount.

"At the same time the examination of the entire Merrick plant revealed the fact that no alum was present, but that the water was milky with aluminium hydrate which had been precipitated by the carbonate in the adjoining wells. The alkalinity of the entire supply from the plant was only 3 parts per million. This shows that the carbonate had been used up in the precipitation of the alum.

"The driven wells at Oconee gave 2.0 parts per million of Al_2O_3, and those at Clear Stream gave 1.6 parts per million. This refers to the entire plant during active operation in each case."

Janeček, G. (Chem. Centbl., 1887, p. 172; (Ausz.) Jahresb. Chem., 1887, p. 2535), reports 0.00272 gm. Al_2O_3 per 1000 gms. in the Jamnicer-alkalisch-muriatischen Säuerlings water.

John, C. v. (Verhandl. Geol. Reichsanst., 1876, p. 114; Jahresb. Chem., 1876, p. 1302), notes 0.1490 part Al_2O_3 per 10,000 parts in well-water from Ločendol, Steiermark.

John, C. v. (Jahrb. Geol. Reichsanst., 31, p. 509; Jahresb. Chem., 1881, p. 1447), reports in spring-water from Ločendol, Austria-Hungary, 0.1490 part Al_2O_3 per 10,000 parts.

John, C. v. (Chem. Centbl., 1891, II, p. 881; Jahresb.

Chem., 1891, p. 2621), found 0.0139 gm. alumina per 10,000 gms. in Friedrichsquelle water from Zeidelweid, Bohemia.

John, C. v. (Jahrb. Geol. Reichsanst. Wien, 48, 375; Chem. Centbl., 70 (1899), II, p. 1047), reported analyses of mineral waters from a number of localities in Eastern Bohemia. The data regarding Al_2O_3 follow:

ALUMINIUM IN SOME MINERAL WATERS FROM EASTERN BOHEMIA.

Kind of Water.	Dry Matter per Liter at 180° C.	Al_2O_3 in Dry Matter.
	Grams.*	Grams.
Lukorna	62.4400	0.0040
Mickňovka	60.6400	.0093
Javůrka	6.6439	.0023
Bučina	3.1002	.0040
Straschov	3.9840	.0400
Bohdaneč Kapelle	1.8080	.0020
Bohdaneč, St. George	3.4720	.0050

* Probably grams per liter—not stated in the abstract cited.

John, C. v., and **H. B. v. Foullon** (Chem. Centbl., 1890, II, p. 772; Jahresb. Chem., 1890, p. 2657) report analyses of four potable springs at Luhatschowitz, namely, Vincenzbrunnen, Amandbrunnen, Johannbrunnen, and Louisenquelle. These contained respectively, 0.004, 0.005, 0.004, and 0.001 alumina (probably parts per 1000).

John, C., and **C. v. Hauer** (Verh. Geol. Reichsanst., 1876, p. 355; Jahresb. Chem., 1876, p. 1302) report 0.0415 part Al_2O_3 per 10,000 parts in Ranigsdorf Säuerling.

Johnstone, W. (Chem. News, 31, p. 15; Jahresb. Chem., 1875, p. 1300), reports 0.1970 gm. $Al_2S_3O_{12}$ per 1000 cc. in Hertfell Spring near Moffat, Scotland.

Johnstone, W. (Chem. News, 39, p. 259; Jahresb. Chem., 1879, p. 1269), reports in St. Dunstan's Well, Melrose, Scotland, 0.019503 gm. aluminium phosphate per 1000 cc.

Johnstone, J. W. (Analyst, 12, p. 90; Jour. Chem. Soc. London, 52 (1887), II, p. 1087), notes in Flitwick water, rising through a ferruginous peat-bed in Flitwick Moor, per 1000 parts, 0.0044 part alumina.

Jolles, A. (Ztschr. Nahrungsmittel u. Hyg., 1892, p. 373; Jahresb. Chem., 1892, p. 2684), found 0.064 gm. alumina per 10,000 gms. in water from the Kärtner Römerquelle in Prevali near Gutenstein.

Jones, W. Black (British Med. Jour., 1903, p. 1055), quotes from the Lancet, 1894, an analysis of Llangammarch mineral water, reporting 3.340 grain alumina and silica per gallon.

Kachler, J. (Wiener. Akad. Ber. (2. Abt.), 70, p. 654; Jahresb. Chem., 1875, p. 1296), reports respectively 0.0743 and 0.0042 part alumina per 10,000 parts in two sour springs near Poschitz, Bohemia.

Kalecsinszky, A. (Ungar. Naturw. Ber., 1, p. 370; Jahresb. Chem., 1886, p. 2321), reports 0.0052 part $H_6Al_2O_6$ per 10,000 parts in iron-water from Rosenau, Comitat Gömör, Hungary.

Kemper (Arch. Pharm., 2d ser., 108, p. 163; Jahresb. Chem., 1861, p. 1096) found a trace of alumina in artesian water from Gosling's Garden at Osnabrück.

Kenrick, E. B. (Geol. and Nat. Hist. Survey, Canada, Chemical Contributions, 1886, p. 13 T), reports "a very small quantity" of alumina in a qualitative analysis of water from Dougherty's so-called carbonic acid spring located in the mountains between Clinton and Carguiles, British Columbia. The total solid matter per 1000 parts in the filtered water was 1.442 parts.

In the same publication (p. 14 T) the author reports a similar analysis of water from a spring at the foot-hills of Western Butte, Sweet Grass Hills, District of Alberta, Northwest Territory. The total solids in the filtered water amounted to 0.857 part per 1000 parts. According to a qualitative analysis it contained a "very small quantity" of alumina.

Kersting (Ann. Chem. Pharm., 90, p. 158; Jour. Prakt. Chem., 63, p. 125; Pharm. Centbl., 1854, p. 589; Jahresb. Chem., 1854, p. 771), in a sulphur-spring water from Schöneck near Segewold, Russia, notes 0.0017 part alumina per 1000 parts.

Knerr, E. B. (Trans. Kansas Acad. Sci., 15 (1895–96), p. 88), notes a trace of alumina in a spring-water from Atchison, reputed to possess medicinal virtues. In the water from a well two and a half miles north of Centralia he notes 3.7 parts alumina per 1,000,000.

Kofler, L. (Vierteljahressch. Prakt. Pharm., 15, p. 161; Jahresb. Chem. Will., 1866, p. 992), reports in the Voralberg springs, Rothenbrunnen, Eisenquelle von Uebersaxen, Eisenwasser des Bad Reuthe, Eisenwasser Bad Andelsbuch, Schwefelwasser Bades Hopfreben, and Quelle zu Raggal, 0.0322, 0.031, 0.0081, 0.0476, 0.0514, and 0.0107 grain Al_2O_3 per pound respectively.

Kónya, S. (Wiener Akad. Ber., 61, 2. Abt., p. 7; Vierteljahresb. Prakt. Pharm., 19, p. 373; Chem. Centbl., 1870, p. 132; Inst., 1870, p. 88; Jahresb. Chem., Naumann, 1870, p. 1387), notes 0.008 part alumina per 10,000 parts in the Bitterwasser from Weilutza near Jassy.

Kosmann (Jour. Pharm., 3d ser., 17, p. 43; Jour. Prakt. Chem., 50, p. 49; Pharm. Centbl., 1850, p. 141; Jahresb. Chem., 1850, p. 627) notes a trace of alumina in mineral water from Niederbronn, Germany.

Kyle, J. J. J. (Chem. News, 38, p. 28; Jahresb. Chem., 1878, p. 1295), reports in Rio de la Plata water taken 8 kilometers above Buenos Ayres 0.0060 part Al_2O_3 per 1000 ccm., and in the Parana water 8 kilometers above its union with the La Plata 0.0030 part Al_2O_3 per 1000 parts.

Lahache, E. (Jour. Pharm. et. Chim., 6th ser., 9 (1899), p. 477), reports "alumina, silica, etc.," as follows, in a number of potable waters from new wells, and old wells recently cleaned, in the region of Tougourt-Ouargla in the Sahara: Tougourt, 0.080; Bled et Amax, 0.088; El Fetir, 0.043; H. Messaoud, 0.035; El-Hadjira, 0.068; H. Dahane, 0.058; H. Debiche et Strifigi, 0.034; Donionidi, 0.049; N'Gonça, 0.005; and Ouargla, 0.008 gm. per liter.

Lane, A. C. (U. S. Geol. Survey, Water-supply and Irrigation Papers, 31, pp. 18–93), in a study of the mineral water of Lower Michigan, cites a number of analyses. The data relating to aluminium are quoted below.* In every case the values are parts per 1000 unless otherwise stated.

In Detroit River water (p. 18) S. H. Douglas (Biennial Rpt. Mich. State Geologist, 1861, p. 204) reports 0.0105 Al_2O_3.

The Dearborn Drug and Chemical Works, Chicago (p. 18),

* Some of the analyses given were cited by Peale (U. S. Geol. Survey Bulletin 32, see p. 103); all such are omitted.

analyzed water from Muskegon Lake, Manistee Lake, Traverse Bay, and Detroit River, finding in the first 0.001 $(FeAl)_2O_3$, and in the others traces of $(FeAl)_2O_3$.

In Lake Superior water (p. 26) W. F. Jackman (Proc. Mich. Pharm. Assoc., 5th year, p. 110) found 0.90 part Al_2O_3 per 1,000,000 parts.

In Shiawassee River water at Owasso, the Dearborn Drug and Chemical Works (p. 27) found 0.001 $(AlFe)_2O_3$ and traces in Battle Creek city water, usually taken from Lake Goguac, Grand River water at Jackson, and water from the creek at Ann Arbor (Huron River?).

G. A. Kirchmaier (p. 27) (An. Rpt. Saginaw Board Water Com., 1892, Sup., pp. 31–33) reports $(AlFe)_2O_3$ as follows: Shiawassee River, 0.0061; Cass River, 0.0070; West Side Pumping Station, Saginaw, 0.007; East Side Pumping Station, 0.0611; and Tittabawassee River, 0.0843. J. E. Graves (p. 27) notes in Chippewa River water (Midland Water Supply) 0.0094 $(AlFe)_2O_3$.

A number of waters from wells and springs in the unconsolidated deposit (Pleistocene) follow (pp. 31–33). Welcome Island lithia water taken three miles north of Pontiac in the center of Lake Angelus, analyzed by J. E. Clark, 0.0014 Al_2O_3; King David Spring, Benton Harbor, analyzed by W. S. Haines, 0.0020 Al_2O_3; Nochemo Spring, Reed City, analyzed by R. Fischer and A. B. Prescott, 0.001 Al_2O_3; and well, 18 feet deep, Ypsilanti, analyzed by Dearborn Drugand Chemical Co., trace Al_2O_3.

In the wells included under the group "Miscellaneous Analyses" (p. 57) are the following: Owasso City supply-wells, analyzed byDearborn Drug and Chemical Works, trace of Al_2O_3, and Hudson Zauberwasser, analyzed by A. B. Prescott, 0.00043 Al_2O_3.

In water of the Midland Mineral Spring (p. 60), said to be 400 feet deep, 0.0247 $Al_2(P_2O_5)_3$ is reported by S. P. Duffield. The analysis is probably the same as that quoted by Peale (U. S. Geol. Survey Bul. 32, see p. 103).

S. P. Duffield (p. 65) reports an analysis of Butterworth's Grand Rapids Magnetic Spring, 261–274 feet deep, with 0.007 Al_2O_3.

Chilton (p. 66) (Biennial Rpt. State Geologist, Michigan, 1860, pp. 171, 186) notes 0.245 $Al_2O_3+SiO_2$ in an East Saginaw well 649 feet deep.

In the group entitled "Water from Devonian or Silurian Limestones" (pp. 72–85) are the following: S. P. Duffield found in wells at Clark's Riverside Bath-house, Detroit, 0.230 Al_2O_3. J. H. Long noted 0.005 Al_2O_3 in water from Excelsior Well, 1400 feet deep, Benton Harbor. In water from Coldwater Prescott notes 0.643 aluminium sulphates. In water from the St. Clair Spring, Oakland House Well, 1250 feet deep, S. P. Duffield reports 12.00 Al_2O_3, and also reports 0.421 Al_2O_3 in the Mount Clemens Original Well, which has also been known as the Avery and Soolbad. T. Tonnelé found 0.044 Al_2O_3 in the water of the Mount Clemens Clementine Well, 1060 feet deep. S. P. Duffield reports 0.601 Al_2O_3 in the Mount Clemens Media Well. C. F. Chandler and C. E. Pellew (Geol. Survey Michigan, 5, pt. 2, p. 46) in Alma wells Nos. 1, 2, and 3, report 5.0325, 3.905, and 4.0823 grains Al_2O_3 per gallon (?), respectively.

A number of miscellaneous analyses are included in the appendix (pp. 91, 93). H. F. Northrup and G. W. Rafter (Special Water-supply Committee of the City Council, Travers City, Rpt., p. 20), note a trace of Al_2O_3 in Lake Michigan water at Chicago. C. G. Wheeler notes a trace of Al_2O_3 in water of the Mount Clemens Pagoda Spring. In water from the Ypsilanti Sanitarium J. E. Clark found 0.15 Al_2O_3.

Lang, E. E. (Verhandl. Ver. Naturkunde Presburg, 2, 1857, pt. 2, p. 1; Jahresb. Chem., 1858, p. 798), reports alumina (parts per 1000) in water from Trentschin Töplitzer Bad, Hungary, as follows: Brünnlein (Urquelle), 0.009 and Spiegelbad, No. 1, 0.017.

Langer, T. (Arch. Pharm., 3d ser., 2, p. 304; Jahresb. Chem., Naumann, 1872, p. 1186), notes traces of alumina in a mineral spring at Mattigbad, Austria.

Lambert, E. G. (Ann. Chim. et Phys., 4th ser., 12, p. 309; Jahrb. Chem. Will., 1867, p. 1043), notes in the sulphur spring of Monterey (Mexico) 0.027 gm. aluminium silicate per liter. The water is used internally and for baths. The occurrence of aluminium is also noted in potable water, sulphur-water, etc., of Maria Island.

Laminne (Jour. Pharm., 3d ser., 13, p. 354; Jour. Chim. Med., 3d ser., 4, p. 461; Pharm. Centbl., 1848, p. 512; Jahresb. Chem., 1847, 1848, p. 1009) found 0.0020 part alumina per 1000 parts in mineral water from Tongern, Belgium.

De Launay (Ann. Mines, 9th ser., 5 (1894), p. 139) quotes an analysis of the mineral waters of Pfaefers-Ragatz, Canton St. Gall, Switzerland, made by Planta-Reichenau. In this water 0.00091 gm. aluminium phosphate per liter is reported, which was calculated to be equivalent to 0.00038 Al_2O_3.

Leber (Pharm. Centbl., 1849, p. 791; Jahresb. Chem., 1849, p. 614) found 0.1157 alumina per 1000 parts in the "new" mineral spring-water from Salzschlirf near Fulda.

Lefort (Jour. Pharm., 3d ser., 16, p. 14; Jahresb. Chem., 1849, p. 617) notes 0.017 gm. aluminium silicate per 1000 cc. in Enclos des Célestins mineral water from Vichy.

Lefort, J. (Jour. Pharm., 3d ser, 21, p. 340; Jahresb. Chem., 1852, p. 757), notes 0.009, 0.008, and 0.005 gm. alumina per 1000 gms. in the "right," "left," and "middle" mineral springs, respectively, at Jenzat, Dept. Allier.

Lefort, J. (Jour. Pharm., 3d ser., 31, p. 84; Jahresb. Chem., 1857, p. 725), found traces of alumina in the following mineral waters from Royat and Chamalières, Dept. Puy-de-Dôme, France; Royat Spring, Cäsarbad, Saint-Mart, and Roches (Beaurepaire) Spring.

Lefort, J. (Jour. Pharm., 3d ser., 32, p. 264; Jahresb. Chem., 1857, p. 726), notes a trace of alumina in mineral water from Neyrac, Dept. d'Ardèche, France.

Legrip (Jour. Chim. Med., 3d ser., 4, p. 83; Pharm. Centbl., 1848, p. 431; Jahresb. Chem., 1847–48, p. 1006) found 0.0074 gm. alumina per 1000 cc. in mineral water from Doulaux, Dept. Creuse.

Le Grip (Jour. Chim. Med., 3d ser., 5, p. 514; Jahresb. Chem., 1849, p. 618) notes 1.75 per cent alumina in total solids of mineral water from Chaumaix, Dept. Creuse, the total solids being equal to 5.80 gms. per 10,000 cc.

Leverett, F. (U. S. Geol. Survey Rpt., 17 (1895–96), pt. II, pp. 701–828), in an article on the water resources of Illinois, gives a number of analyses of water from springs, shallow wells, artesian wells, etc., a number of which, it is stated, were quoted from D. W. Mead's "Hydrography of Illinois." Some of these have been noted from Peale's compilation (U. S. Geol. Survey Bul. 32); others follow. G. H. Ellis (p. 824) reported 0.13 gm. Al_2O_3 per U. S. gallon in Bushnell Railroad Well; W. S. Haines (p. 824) notes 0.08 grains per U. S. gallon in Woodstock "drift" well.

In "St. Peter's" water from Macomb, Ill., G. Steiger (p. 826) reports 0.0013 gm. Al_2O_3 per 1000 cc.

The alumina (grains per U. S. gallon) found in a number of artesian-well waters by different analysts (pp. 827, 828) follows:

ALUMINA IN CERTAIN ARTESIAN WATERS.

Artesian Wells.	Analyst.	Al_2O_3 per U. S. Gal.
		Grams.
Auditorium, Chicago, Ill.	E. G. Smith	.07
Munger's laundry, Chicago, Ill.	E. G. Smith	.03
Davenport, Iowa, glucose factory	E. Guteman	.36
Dekalb, Ill., water-works	G. M. Davidson	.69
Dixon, Ill., water-works	E. G. Smith	.12
Galena, Ill., water-works	W. Simpson	.06
Geneseo, Ill., water-works	D. M. Stanner	8.55
Jerseyville, Ill., water-works	E. G. Smith	.06
Lagrange, Mo., Wyaconda well	?	.09
Macomb, Ill., water-works	G. Steiger	.075
Monmouth, Ill., water-works	E. G. Smith	.10
Montezuma, Ind.	W. A. Noyes	.07
Peru, Ill., water-works	E. G. Smith	.04
Rockford, Ill.	E. G. Smith	.13
Rockford, Ill., water-works	E. G. Smith	.06
Sterling, Ill.	E. G. Smith	.05

In several others a trace of alumina is noted.

Lengyel, B. v. (Földtani Közlöny, 23 (1893), p. 293; Jahrb. Min., 1895, I, Ref. 66; Jour. Chem. Soc. London, 68 (1895), II, p. 118), finds that the Kolop Sulphur Spring, situated near Tisza Süly in the great Hungarian plain, contains **0.0101 gm.** Al_2O_3 per kilogram.

Lepsius, B. (Ber. Deut. Chem. Gesellsch., **21**, p. **552**; **Jour.** Chem. Soc. London, 54 (1888), p. 435), notes 0.00017 gm. $Al_2(PO_4)_3$ per liter in the water of the Tönnissteiner medicinal spring and quotes an earlier analysis by Fresenius, reporting 0.00013 gm.

Lewy (Compt. Rend. Acad. Sci. Paris, 24, p. 449; Jahresb. Chem., 1847–48, p. 1011) reports 1.66 aluminium sulphate per 1000 parts in thermal-spring water from Paramo de Ruiz, New Granada. See also Boussingault (Compt. Rend. Acad. Sci. Paris, 24, p. 397; Ann. Chim. Phys., 3. ser., 20, p. 109; Jour. Pharm., 3. ser., 11, p. 487; Jour. Prakt. Chem., 40, p. 438; Ann. Chem. Pharm., 64, p. 292; Poggendorf's Ann., 71, p. 444; Pharm. Centbl., 1847, p. 414).

L'Hôte, L. (Chem. Centbl., 1891, I, p. 207; Jahresb. Chem., 1891, p. 2620), found 0.0012 gm. alumina in the 2.216 gms. total solids obtained from 1000 cc. of mineral water from Penon de los Banos, Mexico.

Liebig (Ann. Chem. Pharm., 63, p. 127; Jour. Prakt. Chem., 42, p. 463; Pharm. Centbl., 1847, p. 828; Jour. Pharm., 3d ser., 13, p. 65; Jahresb. Chem., 1847–48, p. 1002) notes a trace of aluminium oxid in bitter water from Friedrichshall at Hildburghausen.

Liebig (Ann. Chem. Pharm., 79, p. 94; Pharm. Centbl., 1851, p. 916; Vierteljahressch. Prakt. Pharm., 1, p. 218; Jour. Pharm., 3d ser., 20, p. 315; Jahresb. Chem., 1851, p. 650) examined the sulphur waters of Aachen, reporting traces of aluminium phosphate in Kaiserquelle, Corneliusquelle, Rosenquelle, and Quirinusquelle.

Liebig (Ann. Chem. Pharm., 98, p. 145; Vierteljahressch. Prakt. Pharm., 5, p. 547; Jour. Prakt. Chem., 69, p. 28; Chem. Centbl., 1856, p. 390; Jahresb. Chem., 1856, p. 765) notes the occurrences of traces of aluminium phosphate in the following Kissingen mineral waters: Racoczy, Pandur, and Maxbrunnen.

Liebig (Ann. Chem. Pharm., 98, p. 350; Jour. Prakt. Chem., 69, p. 331; Chem. Centbl., 1856, p. 350; Jahresb. Chem., 1856, p. 766) notes the occurrence of traces of aluminium phosphate in the following mineral waters: Bitter water from Mergentheim, Bonifaciusquelle, Marienquelle, Elizabethenquelle, and Hermannsquelle, the last four at Neuhaus near Neustadt, Germany.

Limouzin-Lamothe (Jour. Chim. Med., 3d ser., 9, pp. 716, 763; Jahresb. Chem., 1853, p. 716) in mineral water from the

Dept. Aveyron, viz., from Prugnes and from Cayla (Princess Spring, Magdalen Spring, and Rose Spring), found alumina as follows: 0.035, 0.050, 0.055, and 0.050 gm. per 1000 cc. respectively.

Liversidge, A. (Chem. News, 42, p. 324; Jahresb. Chem., 1880, p. 1536; Jour. Chem. Soc., London, 40 (1881), p. 564), notes 12.86 parts aluminium chlorid per 100,000 in addition to 4.17 alumina with a trace of ferric oxid in a spring on Kantavu, one of the Fiji Islands.

Liversidge, A. (Chem. News, 62, p. 264; Jour. Chem. Soc. London, 60 (1891), p. 280), in water from a hot spring in Savo Island, notes the occurrence of aluminium.

Liversidge, A. W. Skey, and **G. Gray** (Rpt. Assoc. Adv. Sci. Australasia, 7 (1898), p. 87) have collected analyses of the mineral waters of Australasia. The data regarding aluminium are given on page 94.

In addition to the above traces of alumina are reported by W. Skey (p. 105) in eighteen Te Aroha mineral waters, Queensland. Aluminium and iron are reported together in a number of other waters.

Lord (Geol. Survey Ohio, 6(1888); U. S. Geol. Survey Rpt. 8, pt. II, p. 621) analyzed a brine from a well drilled at Lorain, Lorain County, Ohio, which contained 0.040 part alumina per 1000 parts.

Losanitsch, S. M. (Ber. Deutsch. Chem. Gesellsch. 20, p. 1114; Jour. Chem. Soc. London, 52 (1887), p. 648), reports in mineral waters from Servia Al_2O_3 (parts per 1000) as follows: Wrnjačka banja, 0.00105; Bukowik, 0.00271; Palanka, 0.00199; Alexinačka banja, 0.00279; Ribarska banja, 0.0010; Wranjska banja, 0.0005, and Brestowačka banja, 0.00140.

Löwe, J. (Jahresb. Phys. Ver. Frankfurt a. M., 1853–54, p. 55; Jahresb. Chem., 1854, p. 759), notes in the Kronthal, Germany, Salzquelle, 0.000550 part aluminium silicate per 1000 parts.

Löwe, J. (Jahresb. Phys. Ver. Frankfurt a. M., 1854–55, p. 58; Jahresb. Chem., 1856, p. 770), notes 0.001269 gm. aluminium silicate per 1000 gms. in the Kronthal, Nassau, Germany, Stahlquelle water.

ALUMINIUM IN AUSTRALASIAN MINERAL WATERS.

	Analyst.	Page.	Aluminium Sulphate per Gallon.	Alumina per Gallon.	Aluminium Phosphate per Gallon.	Aluminium Chloride per Gallon.	Aluminium Silicate per Gallon.
			Grains.	Grains.	Grains.	Grains.	Grains.
New Zealand.							
Alkaline water, Auckland.	W. Skey	88	....	.30			
Springs Hanmer, Plains, Nelson	J. v. Haast	89	....	....	trace		
Chlorinated water, Helensville.	W. Skey	89	....	.45			
Chlorinated water, Kopuowhara Mahia	W. Skey	90	....	....	.37	16.42	
Acid alum water, Motuhora (Whale Island, Bay of Plenty.	J. A. Pond	90	48.48				
Acid aluminous water, Ohaeawai, Auckland	J. Hector	92	*a*				
Alum water Onetapu, Desert Auckland.	W. Skey	92	*b*				
Otira Gorge, sulphuretted and siliceous water.	G. Gray	92	....	.21			
Pahua Wairarapa, chlorinated water.	W. Skey	93	....	....	.64		
Chlorinated water, Tologo Bay.	W. Skey	94	....	2.15*c*			
Chlorinated water, No. 1, Waimate Block.	W. Skey	95	....	trace			
Chlorinated water, No. 2, Waimate Block.	W. Skey	95	....	2.86			
Chlorinated water, No. 3, Waimate Block.	W. Skey	95	....	trace			
Weak chalybeate Wairongoa, North Taiera Otoga.	A. G. Kidson-Hunter	95	....	.25			
Alkaline saline water, Waiwera, Auckland.	W. Skey	96	....	trace			
Chlorinated water, *A*, Wanganui.	W. Skey	96	....	....	....	.91	
Chlorinated water, *B* Wanganui.	W. Skey	96	....	....	....	1.22	
Chlorinated water, *C* Wanganui.	W. Skey	96	....	....	....	.21	
Carbonated alkaline water, Whangarei.	J. A. Pond	97	....	....	traces		
Acid water, Lake White Island or Whakaari	J. Hector	97	80.5	....	....	1703.1*d*	
New South Wales.							
Alkaline water, Ballimore.	J. C. H. Mingaye	98	....	trace			
Water Milparinka.	A. H. Jackson	98	....	little			
Queensland.							
Te Pupunitanga Priets's Bath, Roturua District.	W. Skey	100	21.67				

a. Temperature 60°–116° F. Deposits alum and sulphur (amount not stated) on cooling. Total solids, 134.4 grains per gallon.

b. Total solids, 456 grains per gallon, mainly potash, alum and magnesia, and ferrous chlorides.

c. With trace of iron.

d. Sesquichloride.

ALUMINIUM IN AUSTRALASIAN MINERAL WATERS.—*Continued.*

	Analyst.	Page.	Aluminium Sulphate per Gallon.	Alumina per Gallon.	Aluminium Phosphate per Gallon.	Aluminium Chloride per Gallon.	Aluminium Silicate per Gallon.
			Grains.	Grains.	Grains.	Grains.	Grains.
Waikupapapa Saddler's Bath, Roturua District	W. Skey	100	.32				
Waikirihou Vaux's Bath, Roturua District	W. Skey	100	33.22				
Toko Postmasters' Bath, Roturua District	W. Skey	100	1.34				
Arikikapakapa, Roturua District	W. Skey	100	.68				
Te Mimi Okakahi, Roturua District	W. Skey	100	trace				
Ti Kute Great Spring, Roturua District	W. Skey	100	11.22				
Sulphur Bay Spring, Rotorua District	W. Skey	100	trace				
Perekari, Rotorua District	W. Skey	100	trace				
South Australia.							
Wyly's Well Farina	G. A. Goyder	107	....	....	....	....	.91
Spring, The Peake	G. A. Goyder	107	....	....	....	....	.26
Spring, Cadna-owie	G. A. Goyder	107	....	....	....	....	.31
Spring, Andrawilla, Eleanor River	G. A. Goyder	107	....	....	....	....	.42
Healy Springs, Indulkana Springs	G. A. Goyder	107	....	....	....	....	.10
Oolarinna Soakage Well	G. A. Goyder	107	....	....	....	....	.25
Billa-kalina Springs, Strangways	G. A. Goyder	107	....	....	....	....	.45
Sulphur Spring, Strangways	G. A. Goyder	107	....	....	....	....	.75
Nilpinna Spring	G. A. Goyder	107	....	....	....	....	.32
Weedina Spring	G. A. Goyder	107	....	....	....	....	.15
Lake Harry Bore	G. A. Goyder	107	....	....	....	....	.30
Spring Alton Downs, Herbert River, North Territory	G. A. Goyder	107	....	....	....	....	.68

Ludwig, E. (Wiener Akad. Ber., 52, 2. Abt., p. 264; Jahresber. Chem. Will., 1865, p. 934), notes 0.005 aluminium phosphate per 10,000 parts in the thermal spring at Tobelbad, near Gratz, in Steiermark.

Ludwig, E. (Wiener. Akad. Ber., 50, 2. Abt., p. 247; Chem. Centbl., 1865, p. 702; Jahresber. Chem. Will., 1865, p. 935), notes traces of aluminium phosphate in three mineral springs at Mähren, viz., Johannisbrunnen, Neue Quelle, and Paulaquelle.

Ludwig, E. (Min. Petr. Mittheil., 2d ser., 4, p. 519; Jahresb. Chem., 1881, p. 1447), found 0.0053 Al_2O_3 per 10,000 parts in the Sauerquelle from Apatovac, Austria-Hungary.

Ludwig, E. (Min. Petr. Mittheil. 6. p. 150; Jahrseb. Chem., 1884, p. 2035), notes 0.0010 Al_2O_3 per 10,000 parts in Maria Theresia Quelle at Andersdorf, Austria-Hungary.

Ludwig, E. (Die Mineralquellen Bosniens, abs. Chem. Centbl., 1889, II, p. 264; Jahresb. Chem., 1889, p. 2633), reports in the following mineral waters from Bosnia: (1) Thermal spring at Ilidze near Sarajewo; (2) Säuerling from Kiseljack; (3*a*) Säuerling from Bistrica; (3*c*) Säuerling from Ljeskovica (Giftquelle); (4) Rjecicaquelle at Maglaj; (6) Säuerling at Dragunje; (7) Säuerling at Kiseljack near D. Tuzla; and (8) iodine spring at Navioci near Han Sibosica; Al_2O_3 as follows: 0.012, 0.002, 0.006, 0.004, 0.0017, 0.005, 0.001, and 0.021 (probably parts per 10,000).

Ludwig, E. (Tschermak's Mineral. Mittheil. 1890, Jahresb. Chem., 1890, p. 2662), reports 1.319 aluminium sulphate in Cervena-Rjeka-Quelle and 0.146 aluminium sulphate in the Quelle an der Strasse (presumably parts per 10,000 cc.). Both these "vitriol" springs are at Srebrenica, Bosnia. He also reports (Tschermak's Mineral. Mittheil., 1890; Jahresb. Chem., 1890, p. 2663) 13.468 gms. aluminium sulphate per 10,000 cc. in a mineral spring at Büdös (Bálványos) in Siebenbürgen, 0.007 gm. alumina per 10,000 cc. in Karlsquelle; 0.0025 gm. aluminium per 10,000 cc. in Fidelisquelle; and 0.961 part aluminium sulphate per 10,000 parts in the alum spring, all on the Büdös (Stinkberg).

Ludwig, E. (Die Mineralquellen Bosniens, abs. Chem. Centbl., 1890, II, pp. 468. 846; Jahresb. Chem., 1890, p. 2666), reports analyses of mineral-spring waters from Bosnia. The following waters contained alumina (grams per 10,000 in every case): No. 1*a*, saline, Dolnj-Tuzla, 0.005; No. 1*b*, saline, Dolnj-Tuzla, 0.009; No. 2, thermal spring at Gradačac, 0.007; No. 5, sulphur spring, Raso, 0.001; No. 6, Säuerling at Jasenica, 0.006; No. 7, Säuerling at Dubnica, 0.002; No. 8, Säuerling at Tesanj, 0.019; No. 9, thermal spring, Vručica, 0.008; No. 10, thermal spring, Kulasi, 0.007; No. 11, sulphur spring, Smodelac, 0.003; No. 12, thermal spring, Gorni Sehar, 0.001; No. 13, thermal spring, Slatina Ilidze, 0.003; No. 14, Säuerling spring, Slatina Ilidze, 0.005; No. 15, thermal spring at Gata, 0.002;

No. 16, thermal spring at Fojnica, 0.001; and No. 17, thermal spring at Banja Visegrad, 0.001.

Other springs contained aluminium sulphate as follows (grams per 10,000): Waters from Srebrenica (Haldenwasser), No. 4*a*, arsenic vitriol Črni Guber, 2.227; No. 4*b*, arsenic vitriol Mala Kiselica, 1.482; and No. 4*c*, arsenic vitriol Velika Kiselica, 0.384.

Ludwig, E. (Tsch. Min. Mittheil., 16 (1896), p. 133; Jour. Chem. Soc. London, 72 (1897), II, p. 110), notes in a carbonated water from a spring at Seifersdorf, Austrian Silesia, 0.001 parts Al_2O_3 per 10,000, and also notes (Tsch. Min. Mittheil., 16 (1896), p. 140; Jour. Chem. Soc. London, 72 (1897), II, p. 110) 0.002 part Al_2O_3 per 10,000 parts in water from the Constantine Spring in Gleichenberg, Styria.

Ludwig, E. (Wien. Klin. Wochensch., 10 (1897), p. 56; Chem. Centbl., 1897, I, p. 718; Jour. Chem. Soc. London, 74 (1898), II, p. 392), reports 0.004 Al_2O_3 parts per 10,000 in water from the iodine spring at Wels, Upper Austria.

Ludwig, E., and **V. Ludwig** (Wien. Klin. Wochensch., 11 (1898), 207) studied the composition of the acid iron springs at Johannisbrunn in Silicia, reporting per 10,000 parts by weight 0.001 part alumina in Marienquelle and 0.002 part in Paulaquelle.

Ludwig, E., and **J. Mauthner** (Min. Petr. Mittheil., 2d ser., 2, p. 269; Jahresb. Chem., 1880, p. 1524) report analyses of the Carlsbad thermal springs. These contained Al_2O_3 per 10,000 cc. as follows: Sprudel, 0.004 gm.; Marktbrunnen, 0.007 gm.; Schlossbrunnen, 0.005 gm.; Mühlbrunnen, 0.005 gm.; Neubrunnen, 0.006 gm.; Theresienbrunnen, 0.005 gm.; Elizabethquelle, 0.006 gm.; Felsenquelle, 0.003 gm.; Kaiserbrunnen, 0.005 gm. The article (loc. cit., p. 1526) contains a reference to Lerch's analyses made in 1847. He reported 0.005 gm. Al_2O_3 per 10,000 cc. in Orchesterquelle, and 0.006 gm. in Elizabethquelle.

Ludwig, E., and **T. Panzer** (Wiener Klin. Wochensch., 13 (1900), p. 617) note a trace of alumina in the water of the Gastein, Austria, Hauptquelle or Elizabethquelle. They also quote data obtained by earlier analysts. Thus Hünefeld reported 0.016 Al_2O_3 in 1828; Saltmann, 0.027 in 1837;

Wolff, 0.022 in 1845; and Ullik, 0.003 in 1845, parts per 10,000 in every case.

Ludwig, H. (Arch. Pharm., 2d ser., 93 (1858), pp. 129, 257; Jahresb. Chem., 1858, p. 795), notes 0.0054 $Al_2O_3.SiO_3$ per 1000 parts in the cold sulphur-water from Tennstädt, Thuringia.

Ludwig, H. (Arch. Pharm., 2. ser., 133 (1868), p. 1; Jahresb. Chem. Will., 1868, p. 1037), reports per 1000 cc. 0.0033 $Al_2O_3,2SiO_2$ in Friedensquelle from Rostenberg in Sachsen-Weimer-Eisenach.

Lunge, G., and **L. Landolt** (Sep. from Corresp. Schweizer-Aerzt.; Jahresber. Chem., 1885, p. 2317) report 0.0259 gm. Al_2Cl_6 per 1000 gms. in the Schweizerhalle saline spring at Basel.

Lunge, G., and **R. E. Schmidt** (Zeit. Analyt. Chem., 25, p. 309; Jour. Chem. Soc. London, 50 (1886), p. 996), in water of the St. Lorenz hot spring at Leuk, note per kilogram 0.00051 gm. alumina.

Magerstein, V. T. (Verhandl. Geol. Reichsanst., 1879, p. 191; Jahresb. Chem., 1879, p. 1265), reports a trace of Al_2O_3 in two mineral waters from Zuckmantel and Einsiedel, Austria.

Maier, P. J. (Naturk. Tijdschrift. Nederland Indië, 21, p. 1; 22, p. 44; 23, pp. 46, 378; Jahresb. Chem , 1861, p. 1113), found Al_2O_3 (grams per 100) in mineral water from Dutch East India as follows: Spring at Koeningan near the river Tjisangarong, 0.01730; Sissipan Spring, near the river Tjisangarong, 0.01050; spring northeast from the Palimang mountain, 0.00039; Prajan Spring at Res. Madioen, trace; hot spring at the foot of Kaba mountain, 0.00059; and thermal spring on Pengalengen plateau, 0.00038.

Mangini, F. (Gaz. Chim. Ital., 17 (1887), p. 517; Jour. Chem. Soc. London, 54 (1888), p. 1261), in an analysis of the chalybeate water of Raffanelo in the commune of Canale Monterano, reports 0.1350 gm. Al_2O_3 per liter.

Marchand, E., and **E. Leudet** (Jour. Pharm., 37, p. 328; Jahresb. Chem., 1860, p 838) report aluminium salts as follows (grams per 1000 gm.) in mineral water from Blèville, France: 0.0031 $Al_2O_33SO_3$; 0.0151 $Al_2O_3.NH_4O.4SO_3$: 0.0145 $Al_2O_3.KO.4SO_3$; 0.0022 $Al_2O_3PO_5$; and 0.0493 $CaO.Al_2O_3.4SiO_3$.

Mason, W. P. (Chem. News, 61, p. 123; Jour. Chem. Soc., London, 58 (1890), p. 854), reports an analysis of the water of Excelsior Springs near Kansas City, Missouri, which showed 2.10 parts Al_2O_3 per 1,000,000.

Maumené (Compt. Rend. Acad. Sci., Paris, 31, p. 270; Pharm. Centbl., 1850, p. 754; Jahresb. Chem., 1850, p. 626) notes 0.00112, 0.00119, 0.00140, and 0.00197 gm. alumina per 1000 cc., respectively, in water from the Vesle taken on January 23, 1849, at Château-d'Eau; Vesle water taken at the same place June 18, 1849; Vesle water taken June 18, 1849, at Saint-Brice, and water from the Suippe.

Meyer, R. (Ber. Deut. Chem. Gesell., 11 (1878), p. 1521; Jour. Chem. Soc. London, 36 (1879), II, p. 33), in water from the mineral spring at Tenninger Bad, Somvirex Tobel, Grisons, notes 0.0008 part Al_2O_3 and H_3PO_4 per 10,000.

Mingaye, J. C. H. (Jour. Proc. Roy. Soc. New South Wales, 26 (1892), p. 73), reports a number of analyses in a study of some of the well, spring, mineral, and artesian waters of New South Wales and their probable value for irrigation. A potable water from Yarrangobilly caves and one from Jenolan caves each contained a trace of alumina. Other waters contained alumina (parts per 1000) as follows: Water from Jenkins's quarry, 0.0082; from Kidwell's quarry, 0.0104; from Marden's quarry, 0.0126; from Walsh's quarry, 0.0096; water from brewery, Broken Hill, 0.0044; Silverthorne's well, Broken Hill, 0.0030; water from Portion 86, taken from a bore in a limestone quarry, Broken Hill, 0.0004; Wilcannia, water from Tarella, 0.0064; water from Barragan, near Mudgee, trace; Belabula River, Clifden Run, trace; artesian water from Cuttabura, Bourke private bore, and Bourke Corrella Station, trace; and mineral water from Jarvisville, near Picton, Ballinore, Tarbragar River, near Dubbo (artesian), and Rock-Flat Spring, near Cooma, Monara District. each a trace. In one or two other cases alumina with iron is noted.

Mingaye, J. C. (Rpt. Australian Assoc. Adv. Science, 6 (1895), p. 265), in a second paper, which deals with analyses of the artesian waters of New South Wales and their value for irrigation and other purposes, reports alumina as follows (parts per thousand): Kelly's Camp bore, 0.0028 (with a trace of

Fe_2O_3), water from Barringun bore, 0.0036 (with a trace of Fe_2O_3); Corella bore No. 1 (private), trace; Waroo Springs bore, 0.0036 (with a trace of Fe_2O_3); Cuttaburra bore and Dungle Ridge bore, each a trace. In several other waters alumina and ferric oxid are reported together.

Miteregger, J. (Jahrb. Naturhist. Landesmuseums Kärnthen, 1861, No. 5, p. 1; Jahresb. Chem., 1861, p. 1099), notes aluminium (parts per 10,000 cc.) as follows, in water from Radlbad, near Gmünd, 0.820; Säuerling Bades Vellach in Vellathale Hauptquelle No. IV, 0.130; Säuerling Bades Vellach in Vellathale Quelle No. II, 0.189; Säuerling Bades Vellach in Vellathale Quelle No. III, 0.080; Säuerling, Bades Vellach in Vellathale Quelle No. V, 0.100, and Säuerling from Ebriach, near Eisenkappel, 0.130.

Mitteregger, J. (Jahrb. Naturhist. Landesmuseums Kärnthen, 1862, p. 109; Jahresb. Chem., 1862, p. 813), notes alumina per 10,000 gms. in Kärnthen medicinal waters as follows: Katharien-Bad at Klein-Kirchheim, 0.050; Preblauer Sauerbrunnen, 0.040; Sauerbrunnen at Weissenbach in the Lavantthale, 0.140; and Kleininger Sauerbrunnen in the Lavantthale, 0.240.

Moissenet (Ann. Min., 5th ser., 17, p. 7; Jahresb. Chem., 1860, p. 839) reports Al_2O_3 (grams per 1000 cc.) in French mineral waters as follows: Water from Sylvanès, Dept. Aveyron, Source des Moines, 0.0300; Source des Petites Baignoires, 0.0750; Source des Petites-Eaux, 0.0200; Source des Bains Nouveaux, 0.0200; water from Plombières, Sources des Dames, 0.0075, and Source ferrugineuse, 0.1433; and a trace of Al_2O_3 in water from Vittel, near Contrexeville, Dept. Vosges, Source Marie, Source des Demoiselles, and Grand Source.

Moitessier, A. (Compt. Rend. Acad. Sci. Paris, 51, p. 636; Jahresb. Chem., 1860, p. 839), notes 0.0030 gm. alumina per 1000 in the water of the warm spring about 2 km. north of Montpellier, France.

Morelli (Chem. Ztg., 1881, p. 815; Jahresb. Chem., 1881, p. 1448) found 0.0299 part aluminium sulphate per 1000 in one spring and 0.0326 part aluminium sulphate in another at Ceresole Reale, Italy.

Morin, P. (Jour. Pharm., 3d ser., 21, p. 5; Arch. Phil. Nat., 18, p. 224; Jahresb. Chem., 1851, p. 667), found 0.0162 gm. aluminium silicate per 1000 gms. in mineral water from Coëse (Savoy).

Morin, P. (Jour. Pharm., 3d ser., 40, p. 183; Jahresb. Chem., 1861, p. 1106), found 0.0027 gm. alumina per 1000 gms. in mineral water from the Guillot spring at Evian, Savoy.

Muck, F. (Jour. Prakt. Chem., 96, p. 459; Chem. Centbl., 1866, p. 384; Jahresb. Chem., 1865, p. 931), reports in 1000 parts Natronsäuerling from Nassau 0.00060 gram alumina.

Mügge, O. (Jahrb. Min., Beilageband, 4, p. 576; Jahresb. Chem., 1886, p. 2324), reports an analysis by C. Pieper of a hot spring south of Naiwaschasee, Massailand, East Africa. This contained 0.779 gm. $Al_2S_3O_{12}$ per 1000 cc.

Müller, E. (Arch. Pharm., 2d ser., 186 (1868), p. 16; Jahresb. Chem,, 1868, p. 1038), reports per 500 gms. 0.0027 $Al_2O_3PO_5$ and 0.0150 $Al_2O_3.3HO$ in the water of the sulphur spring at Seebruch.

Müller, G. (Neue. Jahrb. Pharm., 3, p. 205; Pharm. Centbl., 1855, p. 526; Jahresb. Chem., 1855, p. 840), reports 0.0340 alumina per 1000 gms. in the Bergstrasse Stahlquelle water from Weinheim.

Müller, G. (Wiener. Akad. Ber., 2. Abt., 58, p. 101; Inst., 1868, p. 384; Jahresb. Chem., 1868, p. 1035), reports traces of Al_2O_3 in the Ida spring at Biloves in Bohemia.

Muspratt, J. S. (Pharm. Jour. Trans., 11, p. 151; Jahresb. Chem., 1851, p. 653), notes traces of alumina in the water of the principal spring at Baden-Baden.

Nasini, R., and **F. Anderlini** (Gaz. Chim. Ital., 24 (1894), I, p. 327; Jour. Chem. Soc., London, 66 (1894), II, p. 422) report 0.0015 Al_2O_3 part per 10,000 by weight in the water of Hot Springs at Monte Irone, Albane.

Netwald (Unters. des Mineralwasser zu Hall bei Kremsmünster, Linz, 1853; Jahresb. Chem., 1853, p. 711) notes in mineral water from Hall near Kremsmünster, Austria, 0.0038 gm. aluminium silicate per 1000 gms.

Northcote, A. B. (Phil. Mag., 4th ser., 14, p. 457; Jahresb. Chem., 1857, p. 727), notes a trace of alumina in the following saline waters from Cheshire, England: Anderton, Marston, Winsford, and Wheelock.

Nuricsan, J. (Földtani Közlöny, 23 (1893), p. 296; Jahrb. Min., 1891, I, Ref. 67; Jour. Chem. Soc. London, 68 (1895), II, p. 118), notes 0.0017 gm. Al_2O_3 per kilogram in the water of the Roman brine spring and 0.0064 in the Shaft spring at Torda, Hungary.

Nuricsany and **Spängler** (Wiener Acad. Ber., 14, p. 121; Pharm. Centbl., 1855, p. 78; Jahresb. Chem., 1854, p. 771) note in mineral water from Roggendorff (Hungary) 0.019 gm. alumina per 1000 gms.

Ochsenius, C. (Ztschr. Geol. Ges., 34, p. 357; Jahresb. Chem., 1882, p. 1626), notes traces of Al_2O_3 in water from the Great Salt Lake, Utah.

Oppermann (Mém. Mus. Strassburg, 4, 1853, p. 21; Jahrb. Min., 1854, p. 184; Jahresb. Chem., 1853, p. 717) notes 0.006250 gm. alumina per 1000 cc. in mineral water from Sulzbach, Alsace.

Orlow, N. A. (Farmaz. Jour., 40, 1901, pp. 2, 26; Ztschr. Untersuch. Nahr. u. Genussmtl., 5 (1902), p. 133), reports 0.0022 gm. Al_2O_3 per 1000 cc. in the Director spring water from Staraja-Russa.

Orlowsky, A. (Ber. Deut. Chem. Gesell., 1883, p. 978 (corresp.); Jahresb. Chem., 1883, p. 1947), notes 0.001904 part Al_2O_3 per 1000 parts in Bolschoi water (used for baths) and 0.001784 part Al_2O_3 per 1000 parts in Kasimer water (used for drinking), both springs in Slawinsk, Poland.

Orosi (Gaz. Toscana, 1847, p. 99; Pharm. Centbl., 1847, p. 413; Jour. Prakt. Chem., 42, p. 468; Jahresb. Chem., 1847–48, p. 1009) found 0.0049 part alumina per 1000 in Mofetta di S. Quirico, water from Tuscany.

Osnaghi (Wien. Acad. Ber., 17, p. 443; Chem. Centbl., 1856, p. 40; Jahresb. Chem., 1855, p. 842) notes 0.010 part alumina per 1000 parts in mineral water from Galdhof, near Seelowitz, Austria.

Otto, R., and **H. Beckurts** (Arch. Pharm., 3d ser., 18, p. 115; Jahresb. Chem., 1881, p. 1444) report 0.0030000 part Al_2O_3 per 1000 parts in Hroswitha water and 0.0035000 part Al_2O_3 in

Wilhelmsquelle; both waters from Herzogludolfsbad, near Gandersheim, Germany.

Parmentier, F. (Compt. Rend. Acad. Sci. Paris, 115, p. 125; Jahresb. Chem., 1892, p. 2687), writing of the occurrence of alumina in mineral water, reports the following in springs at Vichy, Saint-Yorre (Allier) Frobert, 0.008; Saint-Louis No. 1, 0.007; Précieuse, 0.006; Jeanne d'Arc, 0.004; Sévigné, 0.003. In Vichy (Allier) springs: Dubois, 0.015; Vincent, 0.010. In springs at Hauterive (Allier): Bayard, 0.006; Amélie d'Hauterève, 0.001. In Pougues-les-Eaux (Nièvre) springs: Grande Source, 0.014; Jeanne d'Arc, 0.006; Saint-Léon, 0.002; and in the Chatelguyon (Puy-de-Dôme) spring, Yvonne, 0.009 gm. per 1000 cc.

Parmentier, F. (Compt. Rend. Acad. Sci. Paris, 132, 1901, p. 1332; Ztschr. Untersuch. Nahr. u. Genussmtl., 5 (1902), p. 138), states that aluminium occurs in most of the spring-waters previously analyzed by him (for instance, Vichy), although it was not reported.

In Puits Chomel he reports 0.0117 gm. per 1000 cc., and in Grande Grille he reports 0.0075 gm. per 1000 cc. These waters contained flocculent particles of aluminium hydrate.

Parmentier, F. (Compt. Rend. Acad. Sci. Paris, 121 (1895), p. 644; Jour. Chem. Soc. London, 70 (1896), II, p. 195), in a bituminous water from the Grassion spring at Clermont, France, found 0.004 gm. Al_2O_3 per liter.

Passy, A. (Compt. Rend. Acad. Sci. Paris, 68, p. 171; Jahresb. Chem., 1869, p. 1290), notes 0.002 and 0.010 gm. Al_2O_3 per liter, respectively, in spring-water and Aube water from Etufs, France. The analyses were made by H. Magnon.

Paternò, E., and **G. Mazzara** (Gaz. Chim. Ital., 9 (1879), p. 71; Jahresb. Chem., 1879, p. 1266) note a trace of Al_2O_3 in Termini-Imerese water from Palermo, Sicily.

Paternò, E. (Gaz. Chim. Ital., 21 (1891), II, p. 40; Jahresb. Chem., 1891, p. 2619), notes traces of aluminium phosphate in thermal-spring water from Sclafani.

Peale, A. C., of the United States Geological Survey (U. S. Geol. Survey Bulletin No. 32, p. 235), published some years ago a very extended compilation of analyses of waters of mineral springs in the United States. The author states that the information was derived primarily from various State Geological Reports, State guide-books and handbooks, government geological reports, etc., and various other scientific publications. Much additional material was obtained from members of the Geological Survey, and in answer to a special set of inquiries sent throughout the United States. Efforts were made by the compiler to verify in each instance the matter presented in regard to the various localities by direct correspondence. Some eight thousand springs are included in the list, of which about eight hundred had been analyzed. The tables, with a few exceptions, do not include brine springs and wells which are used in the production and manufacture of salt, since such waters are not applied to the ordinary uses of mineral springs. The results are arranged by States and Territories, and the analytical data are in the main incorporated in the tables as given in the sources from which they were taken, except that where originally expressed in grains per fraction of a gallon they were recalculated to grains per gallon. Unless otherwise stated the gallon mentioned is the standard United States gallon or wine gallon of 231 cubic inches. In a number of cases the iron and aluminium were reported together. Such figures have been omitted in preparing the data here given, nor is reference made to those spring-waters in which a trace of alumina was reported. The pages of Dr. Peale's report on which the analyses occur, from which the data regarding aluminium are quoted, are given, as well as the name of the analyst when it was stated. References to the original place of publication are not given, as they were not quoted by Dr. Peale. The following table records the data regarding the occurrence of alumina (Al_2O_3):

AMOUNT OF ALUMINA IN THE WATER OF A NUMBER OF MINERAL SPRINGS IN THE UNITED STATES.

Name of Spring.	Analyst.	Page.	Alumina per Gallon.
Maine.			Grains.
Poland Star Spring.	F. L. Bartlett	15	.32 *a*
Roscicrucian Spring.	S. Dana Hayes	16	.03
Hartford Cold Springs.	....	16	.24
New Hampshire.			
Iron Spring, Milford	G. E. Sewell	17	1.04 *b*
Birchdale Springs, Concord Springs	C. F. Chandler	18	.12
Unity Springs, Iron Spring.	S. Dana Hayes	18	.04
Vermont.			
Middletown Springs, No. 1	Peter Collier	20	.67 *c*
New York.			
Artesian Lithia Spring, Ballston, Spa.	C. F. Chandler	33	.08
Franklin Artesian Well, Ballston, Spa.	C. F. Chandler	33	.26
Washington Lithia Well (old Conde Dentonian), Ballston, Spa.	C. F. Chandler	33	.40
White Sulphur, Chittenango Springs.	C. F. Chandler	33	.08
Cave Spring, Chittenango Springs	C. F. Chandler	33	.22
Cherry Valley Phosphate Spring.	C. F. Chandler	34	.14
Lebanon Thermal Spring.	H. Dussance	35	.45
Richfield Sulphur Spring	T. Deecke	37	.10
Saratoga Champion Spouting Spring.	C. F. Chandler	38	.46
Saratoga Crystal Springs	C. F. Chandler	38	.31
Saratoga Congress Spring.	J. R. Chilton	38	.32
Saratoga Empire Spring.	C. F. Chandler	38	.42
Saratoga Eureka Spring.	Allen	39	.23
Saratoga Flat Rock Spring.	C. F. Chandler	39	.04
Saratoga Hathorn Spring.	C. F. Chandler	39	.13
Saratoga High Rock Springs.	C. F. Chandler	39	1.22
Saratoga Pavilion Spring.	C. F. Chandler	40	.33
Saratoga Pavilion Spring.	J. R. Chilton	40	.42
Saratoga Putnam Spring	J. R. Chilton	40	.56
Saratoga New Putnam Spring.	C. F. Chandler	40	.22
Saratoga A or Alum Spring.	J. G. Pohle	40	.38
Saratoga Seltzer Spring.	C. F. Chandler	40	.37
Saratoga Union Spring.	C. F. Chandler	41	.32
Saratoga United States Spring.	C. F. Chandler	41	.09
Saratoga Vichy Spring.	C. F. Chandler	41	.48
New Jersey.			
Schooley's Mountain Spring.	C. McIntyre, Jr.	43	.14
Warwick Spring.	C. F. Chandler	43	.70

a. With iron. *b.* With soda. *c.* Grains per cubic foot.

ALUMINA IN MINERAL SPRINGS—*Continued.*

Name of Spring.	Analyst.	Page.	Alumina per Gallon.
Pennsylvania.			Grains.
Cresson Magnesia Spring	F. A. Genth	47	.01
Gettysburg Lithia Spring	F. A. Genth	48	.02
Mineral Springs, Hanover	Hollenbush	48	.016
Kane Sulphur Spring	F. A. Genth	49	.03
Maryland.			
Strontia Mineral Spring	W. Simon	53	1.86 *a*
Virginia.			
Bath Alum Spring, No. 1	Hayes	58	10.29
Bath Alum Spring, No. 3	Hayes	58	12.29 *b*
Clifton Spring, No. 1	J. L. Campbell	58	.07 *c*
Blue Ridge Spring	F. A. Genth	59	.14
Farmville Lithia Springs, No. 2	E. T. Fristoe	60	2.52
Mineral Springs, near Farmwell Station, No. 1	R. B. Riggs	60	.0070 *d*
Mineral Springs, near Farmwell Station, No. 3	R. B. Riggs	60	.0105 *d*
Boiler Bath (Old Ladies' Boiler Bath Hot Spring)	F. W. Clarke	61	.0020 *d*
Hot Spout Bath	F. W. Clarke	61	.0025 *d*
Octagon Bath	F. W. Clarke	61	.0035 *d*
New Hot Spring	F. W. Clarke	61	.0060 *d*
Sulphur Bath or Ladies' Sulphur Bath	F. W. Clarke	61	.0065 *d*
Jordan Alum Chalybeate Spring	J. W. Mallet	62	.05
Jordan White Sulphur Springs	T. Antisell	63	.01
Massanetta Mineral Springs	J. W. Mallet	63	.16
Rawley Springs, Main Fountain	J. W. Mallet	63	.05 *c*
Rockbridge Alum Springs, Chalybeate Spring	J. W. Mallet	64	.06
Rockbridge Alum Spring, No. 1	A. A. Hayes	64	14.76
Rockbridge Alum Spring, No. 2	A. A. Hayes	65	17.91
Rockbridge Alum Spring, No. 3	M. B. Hardin	65	43.95
Rockbridge Alum Spring, No. 4	A. A. Hayes	65	24.09
Rock Enon Springs	Gale and Mew	67	.80
Roanoke Red Sulphur Springs	M. B. Hardin	67	.01
Shenandoah Alum Springs	J. W. Mallet	67	12.39 *c*
West Virginia.			
Capon Main Spring	J. W. Mallet	71	.02 *c*
Capon Beauty Spring	J. W. Mallet	71	.02 *c*
Greenbrier White Sulphur Sour Spring	W. B. Rogers	72	16.20 *e*
Salt Sulphur Iodine Spring	D. Stewart	73	.18

a. Parts per 100,000.
b. Also aluminium phosphate. See p. 113.
c. Grains per imperial gallon.
d. Grams per liter.
e. Grains in 100 cubic inches.

ALUMINA IN MINERAL SPRINGS.—*Continued.*

Name of Spring.	Analyst.	Page.	Alumina per Gallon.
North Carolina.			Grains.
Greensborough Spring.	W. C. Kerr, *a*	77	.18
Panacea Spring, near Littleton. . .	W. C. Kerr, *a*	78	.32
Park's Alkaline Mineral Spring....	A. R. Ledoux	78	3.50
Georgia.			
Helicon Springs.	H. C. White	85	.05 *b*
Alabama.			
Johnson's Wells.	W. C. Stubbs	93	12.41
Talladega Spring.	W. C. Stubbs	93	1.45
Mississippi.			
Lauderdale Springs.	L. Harper	97	.00005 *c*
Tennessee.			
Austin's Springs.	A. Dove	103	2.00
Crisp Springs	J. M. Safford	103	.06
Galbraith's Springs.	W. A. Noyes	103	.04
Hurricane Springs.	J. M. Safford	104	.29
Montvale Springs	J. B. Mitchell	104	.50
Tilford's Mineral Well.	J. M. Safford	105	.06
White Cliff Springs.	Troost	106	.08
Kentucky.			
Estill Springs, White Sulphur Spring.	R. Peter	111	.02 *d, e*
Olympian Salt Sulphur Spring. . .	R. Peter	116	.0006 *f*
Olympian White Sulphur Spring .	R. Peter	116	.0021 *f, g*
Kuttawa Mineral Springs.	J. P. Barnum	118	1.20 *f*
Arkansas.			
Hot Springs.	E. H. Larkin	122	.45
Warm Springs.	Wright and Merrill	122	.49
Texas.			
Palo Pinto Well	A. Merrill	127	1.54
Wootan Well, No. 1.	C. F. Chandler	128	1.22
Wootan Well, No. 2.	W. M. Mew	128	1.56
Wootan Well, No. 4:	W. M. Mew	128	3.46
Ohio.			
Green Mineral Spring.	O. N. Stoddard	133	.98
Ohio Magnetic Spring.	E. S. Wayne	134	.12
Cedar Springs, Washington Spring.	A. Fennel	134	.22
Indiana.			
Greencastle, North or Daggy Spring.	E. T. Cox	138	.19 *b*

a. Reported in Geol. North Carolina, 1 (1875).
b. Grains per imperial gallon.
c. Parts per 100.
d. Grains per 1000.
e. With trace of phosphates.
f. Parts per 1000.
g. With iron and manganese carbonates.

ALUMINA IN MINERAL SPRINGS.—*Continued.*

Name of Spring.	Analyst.	Page.	Alumina per Gallon.
Indiana.			Grains.
Greencastle, Middle or Dewdrop Spring	E. T. Cox	138	.09 *a*
Marion Artesian Well	....	139	.35 *a*
West Saratoga Spring, No. 1	E. T. Cox	140	.22 *a*
West Saratoga Spring, No. 2	E. T. Cox	140	.43 *a*
Illinois.			
Alcyone Mineral Springs	Wheeler and Blaney	144	1.99 *a*
Glen Flora Springs	J. V. Z. Blaney	144	.15
Versailles Mineral Spring, No. 1	J. V. Z. Blaney	144	.73*a*, *b*
Rockford Artesian Well, No. 1	E. G. Smith	144	.0009 *c*
Michigan.			
Riverside Magnetic Spring, No. 2	....	147	.51 *d*
Butterworth's Magnetic Spring,	S. P. Duffield	147	.49 *a*
Grand Haven Mineral Spring	C. G. Wheeler	148	.30
Mount Clemens Mineral Well	S. P. Duffield	148	29.47
Mount Clemens Media Spring	S. P. Duffield	148	29.00
Mount Clemens Soolbad Spring	S. P. Duffield	148	11.21
Warner's Spring	....	150	.25
Wisconsin.			
Arctic Spring	W. W. Daniels	153	.15
Bethesda Springs, Waukesha	C. F. Chandler	153	.12
Black Earth Mineral Springs	A. C. Barry	153	1.00 *e*
Buckhert's Fountain	G. Bode	153	.16
Eureka Springs	G. Bode	154	.19 *c*
Fountain Springs	J. V. Z. Blaney	154	.09
Gibson Springs	G. Bode	154	.13 *c*
Glen Springs	F. C. Chandler	154	.05
Gomber's Well	....	154	.13
Hacket's Spring	G. Bode	154	.11
Horeb Springs	G. Bode	154	.23
Hygeia Springs	A. Thiel	154	.72
Iodo-Magnesian Springs	F. C. Chandler	154	.06
Jacob's Artesian Well	G. Bode	154	.19
Jordan's Mineral Well	G. Bode	154	.68
Palmyra Springs, Zenobia's Fountain	G. Bode	155	.22
Palmyra Springs, Eye Springs	G. Bode	155	.19
St. Croix Mineral Spring	J. V. Z. Blaney	155	.49
Shealtiel Mineral Springs	G. Bode	156	.09
Sheboygan Mineral Spring	G. Bode	156	1.10
Sheboygan Mineral Spring	C. F. Chandler	156	.13
Sheridan Springs	G. Bode	156	.05
Silurian Spring	W. S. Haines	156	.59
Vesta Spring	G. Bode	156	.13

a. Grains per imperial gallon.
b. With trace of iron.
c. Parts per 1000.
d. With calcium phosphates.
e. Apparently parts per 100 of total ash.
f. With iron.

ALUMINA IN MINERAL SPRINGS.—*Continued.*

Name of Spring.	Analyst.	Page.	Alumina per Gallon.
Wisconsin.			Grains.
White Rock Spring	I. Campbell Browne	157	.75 *a*
Utley Mineral Spring	C. D. Marsh	157	.000411 *b*
Artesian Mineral Well, Prairie du Chien	G. Bode	157	.0610
Park Spring	Daniels	157	.0467
Minnesota.			
Owatonna Vichy Spring	Enno Sander	159	.10
Owatonna Mineral Spring (name unknown)	....	159	.28
Humboldt's Salt Well	J. A. Dodge	159	2.38
Dakota.			
Artesian Well at Aberdeen	Erastus G. Smith	161	.0816
Mineral Well at foot of bluff at Pierre	G. A. Mariner	161	.01
Iowa.			
Iowa Acid Spring	J. H. Siebel	162	226.41
Cherokee Magnetic Mineral Springs	J. W. Draper	163	.29
Siloam Springs	G. Bode	163	.1170
Missouri.			
Bowsher Mineral Spring	P. Schweitzer	168	.6484
Columbia Chalybeate Springs	P. Schweitzer	168	.79
Climax Springs	H. W. Wiley	168	5.08 *c*
Landreth's Mineral Well	P. Schweitzer	169	.67
Sweet Springs near Brownville, Akesion Spring	C. P. Williams	169	.17
Sweet Springs near Brownville, Sweet Spring	C. P. Williams	169	.09
New Baden Springs	P. Schweitzer	169	.22
Kansas.			
Flowing Spring	Barnes and Sim	175	.21
Pfister's Spring	Barnes and Sim	175	1.12
Haddon Mineral Well	E. H. Failyer	175	1.4083
Montana.			
Hunter's Hot Spring	W. A. Noyes	180	.12 *d*, *f*
Utah.			
Utah or Bear River Hot Springs	F. W. Clarke	187	.0040 *e*
Colorado.			
Hartsel Hot Mineral Springs	G. E. Patrick	192	.65 *d*

a. Grains per imperial gallon.
b. Parts per 100.
c. With iron oxid.
d. Parts per 100,000.
e. Parts per 1000.
f. Aluminium.

ALUMINA IN MINERAL SPRINGS—*Continued.*

Name of Spring.	Analyst.	Page.	Alumina. per Gallon
California.			Grains.
El Paso de Robles Hot Sulphur Spring	Price and Hewston	210	.22 *a*
Skagg's Hot Springs	E. W. Hilgard	211	.01
Highland Seltzer Spring	Rising	212	1.56
Highland Dutch Spring	Rising	212	.11
Highland Magic Spring	Rising	212	.17
Mono Basin Warm Springs	T. M. Chatard	212	.0018 *b*
Summit Soda Spring	J. F. Rudolph	214	1.75
Tolenas Springs	J. Hewson, Jr.	214	.96
Washington.			
Medical Lake	G. A. Mariner	218	.175

a. Grains per imperial gallon. *b.* Grams per liter.

The following table reports data on the occurrence of aluminium sulphate in mineral waters of the United States:

AMOUNT OF ALUMINIUM SULPHATE IN THE WATER OF A NUMBER OF MINERAL SPRINGS IN THE UNITED STATES.

Name of Spring.	Analyst.	Page.	Aluminium Sulphate per Gallon.
New York.			Grains.
Oak Orchard Acid Springs, No. 1	Silliman and Norton	37	21.69
Oak Orchard Acid Springs, No. 1	J. R. Clinton	37	9.68
Oak Orchard acid water	Porter	37	6.41
" " " "	H. Erni	37	.37 *a*
" " " "	W. J. Craw	37	.32 *a*
Pennsylvania.			
Cresson Iron Spring	F. A. Genth	47	1.60
Cresson Alum Spring	F. A. Genth	47	21.20
Kittanning Mineral Spring	F. A. Genth	48	1.53
Blossburg Spring	F. A. Genth	49	6.58
Guylyck and Gaylord's Spring	S. A. Lattimore	49	.55
Virginia.			
Bath Alum, No. 2	W. H. Taylor	58	29.99
Cave Springs	W. H. Taylor	58	.02
Bedford Iron and Alum Springs	M. B. Hardin	59	24.18
Bedford Iron and Alum Springs	W. Gilham	59	7.24
Buffalo Lithia, No. 1	W. P. Tonry	59	8.18 *b*
Buffalo Lithia, No. 2	W. P. Tonry	59	9.07 *b*
Buffalo Lithia, No. 4	W. P. Tonry	59	3.04 *b*

a. Parts per 1000. *b.* Grains per imperial gallon.

ALUMINIUM SULPHATE IN MINERAL SPRINGS—*Continued.*

Name of Spring.	Analyst.	Page.	Aluminium Sulphate per Gallon.
			Grains.
Cold Sulphur Springs	....	59	.25
Church Hill Alum Springs	J. C. Booth	60	72.93 *a*
Jordan Alum Springs alum spring	W. E. K. Aiken	62	25.38
Jordan Alum Springs, No. 2	J. W. Mallet	62	11.20
Jordan Alum Springs, No. 3	J. W. Mallet	62	6.88
Jordan Alum Springs, No. 4	J. W. Mallet	62	81.05
Jordan Alum Springs, No. 5	J. W. Mallet	62	26.11
Jordan Alum Springs, No. 6	J. W. Mallet	62	27.85
Pulaski Alum Spring	J. L. Campbell	63	21.59
Orkney Healing Spring	J. W. Mallet	64	.03
Orkney Powder Spring	J. W. Mallet	64	.02
Orkney Bear Wallow Spring	J. W. Mallet	64	.06
Rockbridge Alum Spring, No. 1	M. B. Hardin	64	31.25
Rockbridge Alum Spring, No. 2	M. B. Hardin	65	42.61
Rockbridge Alum Spring, No. 4	M. B. Hardin	65	72.37
Rockbridge Alum Spring, No. 4	M. B. Hardin	65	19.00
Rockbridge Alum Spring, No. 5	J. W. Mallet	65	11.20
Rockbridge Alum Spring, No. 6	J. W. Mallet	65	6.88
Rockbrigde Alum Spring, No. 7	J. W. Mallet	65	81.05
Rockbridge Alum Spring, No. 8	J. W. Mallet	65	26.11
Rockbridge Alum Spring, No. 9	J. W. Mallet	65	27.85
Stribling or Augusta Alum Spring	J. L. Campbell	66	16.68 *a*
Stribling or Augusta Alum Spring, No. 4	D. K. Little	66	16.69
Stribling or Augusta Alum Spring, No. 5	D. K. Little	66	17.95
Stribling or Augusta Alum Spring, No. 6	D. K. Little	66	38.41
Seven Springs, Abingdon	J. W. Mallet	67	15.22 *b*
Variety Springs, Alum Spring	W. Gilham	67	34.43
Wallawhatoola Alum Springs	J. L. Campbell	68	72.10
Wallawhatoola Alum Springs	C. F. Chandler	68	137.889 *c*
Yellow Sulphur Springs	W. Gilham	68	3.18
West Virginia.			
Greenbrier White Sulphur Springs (name unknown)	W. B. Rogers	72	.02
Irondale Springs	Breneman	73	11.34
Georgia.			
Catoosa Spring, No. 9, "White Sulphur"	W. J. Land	83	2.47
Catoosa Spring, No. 10, "Buffalo"	W. J. Land	83	2.38
Catoosa Spring, No. 1, "All-healing"	W. J. Land	83	.50
Catoosa Spring, No. 2, "Red Sweet"	W. J. Land	83	.66

a. Bisulphate. *b.* Parts per 100.

c. Also 4.201 grains potassium and aluminium sulphate and 3.867 grains sodium and aluminium sulphate.

ALUMINIUM SULPHATE IN MINERAL SPRINGS—*Continued.*

Name of Spring.	Analyst.	Page.	Aluminium Sulphate per Gallon.
			Grains.
Catoosa Spring, No. 4, "Chalybeate"	W. J. Land	84	.67
Catoosa Spring, No. 3, "Cosmetic"	W. J. Land	84	2.36
Catoosa Spring, No. 5, "Magnesia"	W. J. Land	84	.69
Catoosa Spring, No. 6, "Congress"	W. J. Land	84	.52
Catoosa Spring, No. 7, "Alum"	W. J. Land	84	1.10
Catoosa Spring, No. 8, "Black Sulphur"	W. J. Land	84	1.42
Chalybeate Springs	W. J. Land	84	.43
Mississippi.			
Cooper's Well	J. Lawrence Smith	97	6.12
Tennessee.			
Raleigh's Mineral Springs, Box Spring	Enno Sander	105	.153 *a*
Raleigh's Mineral Springs, Marble Spring	Enno Sander	105	.086 *a*
Kentucky.			
Estill Springs, Black Sulphur Spring	R. Peter	111	.02 *b*
Kentucky Alum Springs	L. D. Kastenbine	114	40.26
Hickman's Springs, No. 1, Alum	R. Peter	114	1.25 *b*
Hickman's Springs, No. 2, Alum	R. Peter	114	.33 *b*
Hickman's Springs, No. 6, Sweet	R. Peter	114	.35 *b*
Louisville Artesian Well	J. Lawrence Smith	115	1.80 *c*
Paroquet Springs	J. Lawrence Smith	115	.49
Davis Mineral Well	E. S. Wayne	118	83.16
Arkansas.			
Ravenden Spring	Wright and Merrill	122	2.36
Texas.			
Fairview Springs	....	127	5.40 *d*
Sour Lake Mineral Spring, No. 7	F. W. Mallet	128	45.52
Sour Lake Mineral Spring, No. 9	F. W. Mallet	128	31.28
Weaver Well	J. K. Wright	128	23.24
Sour Springs, Caldwell County	H. H. Dinwiddie	128	100.08 *e*
Ohio.			
Cuyahoga Lithia and Magnesia Springs, Bitter Water	....	133	515.51
Indiana.			
French Lick Springs, Pluto's Well	E. T. Cox	138	5.98 *f*

a. Grams per 10,000.
b. Grains per 1000.
c. Also 1.21 grains aluminium chloride.
d. Including alumina.
e. Including potassium sulphate.
f. Grains per imperial gallon.

ALUMINIUM SULPHATE IN MINERAL SPRINGS—*Continued.*

Name of Spring.	Analyst.	Page.	Aluminium Sulphate per Gallon.
			Grains.
Indian Spring	E. T. Cox	139	.99
Hosea Saline Sulphur Spring	E. T. Cox	139	11.67 *a*
West Baden Spring, No. 1	E. T. Cox	141	5.41 *a*
Missouri.			
Bratton Spring	P. Schweitzer	168	52.45 *b*
Moresville Mineral Springs	Wright and Merrill	169	5.20
Nevada.			
Hot Springs at Hot Springs Station	T. M. Chatard	202	.0063 *c*
California.			
Thermal Acid Spring	O. Loew	210	127.00 *d*

a. Grains per imperial gallon.
b. Tersulphate.
c. Grams per liter.
d. Persulphate, parts per 100,000.

The table following reports the occurrence of aluminium phosphate in the mineral waters of the United States:

AMOUNT OF ALUMINIUM PHOSPHATE IN MINERAL WATERS OF THE UNITED STATES.

Name of Spring.	Analyst.	Page.	Aluminium Phosphate per Gallon.
Virginia.			Grains.
Alleghany Springs	F. A. Genth	58	.03 *a*
Bath Alum, No. 3	Hayes	58	3.15 *b*
Wolf Trap Lithia Springs	M. B. Hardin	68	.04
West Virginia.			
Borland Mineral Well	T. G. Wormley	71	.23
Hart Well	S. C. Wells	73	.23
Michigan.			
Midland Magnetic Well	S. P. Duffield	148	1.73 *c*
Wisconsin.			
Sparta Mineral Magnetic Well	J. M. Hirsh	156	.06 *c*

a. Also aluminium silicate. See p. 114. *b.* Also alumina. See p. 106.
c. Grains per imperial gallon.

Several authors report the occurrence of aluminium silicate. Such data are summarized in the following table:

AMOUNT OF ALUMINIUM SILICATE IN MINERAL WATERS OF THE UNITED STATES.

Name of Spring.	Analyst.	Page.	Aluminium Silicates per Gallon.
Virginia.			Grains.
Alleghany Springs.	F. A. Genth	58	.21 *a*
Alabama.			
Cullum's Ferruginous Spring.	Abequin	92	3.320
Illinois.			
Perry Spring, No. 3, Lower Sulphur.	H. Engelman	144	.27

Also aluminium phosphate. See p. 113.

In addition to the above it should be noted that an analysis quoted by Dr. Peale (p. 133) reports in Cuyahoga Lithia and Magnesia Springs, Lithia Well, Ohio, 17.67 aluminium chloride (grains per gallon).

Pettenkofer (Ann. Chem. Pharm., 77, p. 183; Jahresb. Chem., 1851, p. 653) in the Adelheid spring at Heilbrunn, Bavaria, reports 0.1424 grain alumina per pound (7680 grains).

Philippi (Jahrb. Vereins Naturk. Nassau, Pt. 8, 1852, p. 90; Pharm. Centbl., 1853, p. 12; Jahresb. Chem., 1852, p. 753) notes a trace of alumina in Wiesbaden Faulbrunnen.

Phillips, J. A. (Chem. News, 27, p. 62; Proc. Roy. Soc. London, 21, p. 132; Phil. Mag., 4th ser., 46, p. 26; Jahresb. Chem., Naumann, 1873, p. 1243), reports in two analyses of a saline spring at Camborne, Cornwall, 0.3456 and 0.3460 gram alumina per liter.

Pistor, C. (Ber. Deut. Chem. Gesell., 17 (1884), p. 2894; Jahresb. Chem., 1884, p. 2033), reports 0.0450 gm. Al_2O_3 per 1000 cc. in Römerbrunnen from Echzell in Wetterau.

Planta (Ann. Chem. Pharm., 115, p. 330; Chem. Centbl., 1860, p. 1010; Jahresb. Chem., 1860, p. 837) notes 0.00004 gm. aluminium phosphate per 1000 gms. in the medicinal spring at Bormio, Italy.

Planta and **Kekulé** (Ann. Chem. Pharm., 87, p. 364; Pharm. Centbl., 1854, p. 59; Jahresb. Chem., 1853, p. 713) found in sulphur-water from Serneus, Switzerland, Canton Graubünden, 0.0012 part alumina per 1000 parts.

Planta and **Kekulé** (Ann. Chem. Pharm., 90, p. 316; Pharm. Centbl., 1854, p. 642; Jour. Prakt. Chem., 63, p. 61; Jahresb. Chem., 1854, p. 763) examined the mineral waters of St. Moritz, Canton Graubünden, Switzerland, finding alumina as follows: Large (old) spring 0.0003 and Small (new) spring 0.0004 (parts per 1000).

Planta-Reichenau, A. v. (Die Heilquellen von Alveneu, Tiefenkasten, Solis in Graubünden, etc., 1865; Ann. Chem. Pharm., 136, p. 145; Jahresber. Chem. 1865, p. 935), notes 0.0047 part aluminium phosphate per 1000 parts in the sulphur spring at Alveneu and 0.0068 part in the Donatusquelle in Albulathale. A trace of alumina is noted also in St. Petersquelle at Tiefenkasten.

Planta-Reichenau, A. v. (Ann. Chem. Pharm., 155, p. 161; Chem. Centbl., 1870, p. 581; Amer. Chemist, 2d ser., 1, p. 228; Jahresb. Chem., Naumann, 1870, p. 1383), reports 0.0091 part aluminium phosphate per 10,000 parts in the Ragaz-Pfäffers thermal spring.

Planta-Reichenau, A. v. (Ber. Deut. Chem. Gesell. (1878), p. 1793; Jahresb. Chem., 1878, p. 1306; Jour. Chem. Soc. London, 1879, II, p. 126), reports 0.074, 0.068, and 0.013 part aluminium phosphate per 10,000 parts in Natural Soda-water from Passug, Iodine Donatus from Solis, and in St. Petersquelle from Tiefenkasten, respectively.

Plumert, A. (Chem. Centbl., 1884, p. 423 (Ausz.); Jahresb. Chem., 1884, p. 2037), reports 0.206 part aluminium sulphate per 10,000 parts in the thermal sulphur-spring water from Tschéhirghé, and 0.918 part aluminium sulphate per 10,000 parts in similar water from Bad Jeni-Kaplidja, both in Anatolia.

Poggiale and **Lambert** (Compt. Rend. Acad. Sci. Paris, 54, p. 1062; Jour. Pharm., 41, p. 337; Instit., 1862, p. 172; Rép. Chim. Appliquée, 4, p. 214; Jahresb. Chem., 1862, p. 817) report 0.001 gm. Al_2O_3 per 1000 gms. in warm water from an artesian well at Passy, France.

Pohl, J. J. (Wien. Acad. Ber., 15, p. 303; Jahresb. Chem., 1855, p. 842), found traces of alumina in a spring-water from Vienna (Josefstadt).

Poleck, T. (Jour. Prakt. Chem., 52, p. 353; Pharm. Centbl., 1851, p. 540; Jahresb. Chem., 1851, p. 654), notes 0.00960 grain aluminium phosphate per pound (7680 grains) in mineral water from Nieder-Langenau, and also reports an analysis by Duflos of the same water in which the occurrence of a trace of aluminium phosphate is noted.

Poleck, T. (Ber. Deut. Chem. Gesellsch., 1879, p. 1902; Jahresb. Chem., 1879, p. 1263), reports 0.0087 gm. $Al_2P_2O_8$ per 10,000 cc. in the Oberbrunnen at Flinsberg, Silesia.

Poleck, T. (Kronenquelle zu Salzbrunn, Breslau, 1882; Jahresb. Chem., 1884, p. 2034), notes 0.00047 Al_2O_3 and 0.00036 part $Al_2P_2O_8$ per 1000 parts in the Kronenquelle at Salzbrunn.

Poumarède (Rev. Sci. Ind., 38, p. 21; Jahresb. Chem., 1850, p. 627) reports 0.028 gm. alumina per 1000 cc. in mineral water from Vilaine-Saint-Aubin, Dept. Loiret.

Power, F. B. (Jour. Prakt. Chem., 2d ser., 19, p. 223; Jour. Chem. Soc. London, 36 (1879), II, p. 698), notes 0.0019 Al_2O_3 part per 10,000 parts in mineral water of Rosheim, Alsace.

Pozziale (Jour. Pharm., 3d ser., 24, p. 277; Jahresb. Chem., 1853, p. 716) notes 0.006 gm. alumina per 1000 gm. in mineral water from Orezza in Corsica.

Pozziale (Jour. Chim. Med., 3d ser., 9, p. 81; Jour. Pharm., 3d ser., 23, p. 114; Jahresb. Chem., 1853, p. 718) found 0.0150 and 0.018 part alumina per 1000 parts in Bullicame sulphur-water and the iron-water, respectively, from Viterbo.

Pribram, R. (Chem. Untersuchung der Arsenquelle zu Dorna-Sara Czernowitz; Jahresb. Chem., 1885, p. 2318), notes 0.00112 part Al_2O_3 per 1000 in the Roumanian arsenic spring at Dorna-Sara.

v. Radziszewski (Arch. Pharm., 3d ser., 13 (1878), p. 459; Jahresb. Chem., 1879, p. 1265) notes a trace of aluminium in Carlsquelle and Ameliaquelle water from Iwoniez, Austria-Hungary.

Rasenack, P. (Arbt. K. Gsndhtsamt., 5, p. 370; Chem. Centbl., 1889, II, p. 166; Jahresb. Chem., 1889, p. 2632), notes a trace of aluminium in mineral water from the neighborhood of Bimbia, Africa.

Reade, T. M. (Silliman's Amer. Jour., 3d ser., 29, p. 290; Jahresb. Chem., 1885, p. 2315), reports analysis of river-water. Mississippi water contained 3.13 parts Al_2O_3 per 100,000 (1.753

grains per gallon); Amazon River water, 0.38 part Al_2O_3 (with Fe_2O_3) per 100,000.

Reibenschuh, A. F. (Wiener. Akad. Ber., 62, 2. Abt., p. 786; Jahresb. Chem., Naumann, 1870, p. 1385), notes in water from the Johannis spring which is near Stainz in Steiermark 0.0269 part aluminium phosphate per 10,000 parts.

Reibenschuh, A. F. (Mitt. Ver. Steiermark, 30 (1894), p. 358; Jour. Chem. Soc. London, 70 (1896), II, p. 435), in water from the Radein (Styria) Sauerbrunnen found 0.0092 part Al_2O_3 per 10,000 parts.

Reibenschuh, A. F. (Mitt. Ver. Steiermark, 29 (1893), p. 262; Jour. Chem. Soc. London, 70 (1896), II, p. 435), notes 0.05371 part Al_2O_3 per 10,000 parts in water from the Semlitsch spring at Radein.

Reibenschuh, A. F. (Mitt. Ver. Steiermark, 34 (1898), p. 177; Jour. Chem. Soc. London, 76 (1899), II, p. 308), notes in water from the Neubrunnen at Radein, Styria, 0.10191 gm. Al_2O_3 per 10,000 gms.

Reichardt, E. (Arch. Pharm., 3d ser., 2 (1873), p. 124; Jahresb. Chem., Naumann, 1873, p. 1237), reports in Neue Stahlquelle from Lobenstein, Agnesquelle from Lobenstein, and spring-water from Steben, respectively, 0.00397, 0.00122, and 0.00386 part alumina per 1000 parts.

Reichardt, E. (Arch. Pharm., 3d ser., 16 (1880), p. 208; Jour. Chem. Soc. London, 40 (1881), p. 29), in the water of the Grosslüder mineral spring at Salzschlirf reports 0.0045 gm. Al_2O_3 per 1000 gms.

Reiner, M. (Wien. Akad. Ber., 56, 2. Abt., p. 456; Wiener Akad. Anz., 1867, p. 178; Jour. Prakt. Chem., 102, p. 58; Chem. Centbl., 1868, p. 384; Inst., 1868, p. 30; Jahresb. Chem., 1867, p. 1038), reports 0.088 part aluminium phosphate per 10,000 parts in the Wiener-Neustadt Sauerbrunn.

Reinsch (Jahrb. Prakt. Pharm., 21, pt. 3; Arch. Pharm., 2d ser., 67 (1851), p. 47; Jahresb. Chem., 1851, p. 666) notes 0.009457 gm. aluminium chloride per 1000 cc. in mineral water from Sulz (Alsace).

Riggs, R. B. (U. S. Geol. Survey Bul. 42, p. 147), reports analysis of two springs one mile from Farmwell Station, Loudoun County, Virginia. Spring A contained 0.0070 and Spring B, 0.0105 gm. Al_2O_3 per liter.

Riggs, R. B. (U. S. Geol. Survey Bul. 42, p. 148), in water from Beck's Hot Springs, near Salt Lake City, Utah, reports 0.0090 gm. Al_2O_3 per liter.

Riggs, R. B. (U. S. Geol. Survey Bul. 55, p. 91), in artesian-well water from Albany, Georgia, and Fitzpatrick, Alabama, reports 181.0 and 271.0 parts total solids per million, 1.0 and 2.4 being Al_2O_3. In similar wells at Smithville, Americus, and Montezuma, Ga., he reports traces of Al_2O_3.

Rivier and **Fellenberg** (Arch. Phil. Natur., 21, p. 59; Jahresb. Chem., 1853, p. 714) note a trace of alumina in mineral water from Saxon (Canton Wallis), Switzerland. It is stated that Morin (Arch. Phil. Nat., 22, p. 52; Jour. Pharm., 3d ser., 23, p. 188; Jour. Prakt. Chem., 58, p. 483; Pharm. Centbl., 1853, p. 325; Jahresb. Chem., 1853, p. 714) found 0.0005 part alumina per 1000 parts in the same water. Heidepriem and Poselger (Jour. Prakt. Chem., 58, p. 473; Pharm. Centbl., 1853, p. 324; Jahresb. Chem., 1853, p. 714) also note a trace of alumina in this water, as did Braun in two analyses reported by Rivier and Fellenberg (Jour. Prakt. Chem., 59, p. 303; Jahresb. Chem., 1853, p. 715).

Robinson, A. E., and **C. F. Mabery** (Jour. Amer. Chem. Soc. 18 (1896), p. 915; Jour. Chem. Soc. London, 72 (1897), II, p. 510), report in bittern water from a boring 2667 feet deep at Conneautsville, Crawford County, Pennsylvania, 31.1 parts $AlCl_3$ per 100,000.

Roux (Compt. Rend. Acad. Sci. Paris, 73, p. 910; Jour. Chem. Soc. London, 24 (1871), p. 1181)$_2$ reports 0.00720 gm. aluminium silicate per liter in the water of an artesian well at Rochefort.

Rupp, G. (Ztschr. Ang. Chem., 1891, p. 448; Jahresb. Chem., 1891, p. 2618), in a steel spring at Bad Griesbach found 0.003 gm. alumina per 1000 cc.

Russell, I. C. (U. S. Geol. Survey Bul. 108, p. 93/, notes that T. M. Chatard found in Owens Lake (California) 0.023 part Al_2O_3 per 1000 parts.

Russell, I. C. (U. S. Geol. Survey Bul. 52, p. 38), quotes an analysis of James River, Va., water reported by W. H. Taylor

(An. Rpt., Richmond (Va.) Board of Health, 1876). The account of Al_2O_3 noted is 0.00041 part per 1000 parts.

Russell, I. C. (U. S. Geol. Survey Mon. 11, Tables, p. 176), quotes a number of analyses of American rivers, inclosed lakes and springs. Some of these have been noted already from other publications. Others follow, the values given in every case representing parts per 1000. Hydrant (river) water from Los Angeles, California, according to W. J. Jones (Rpt. Cal. State Board Health, 1878) contains 0.00171 part Al_2O_3 and hydrant (river) water from Sacramento, California, 0.00120 part Al_2O_3. E. R. Horsford (Geol. of New Jersey, 1868, p. 703) notes 0.01342 part Al_2O_3 in Pasaic River water taken four miles above Newark. T. M. Chatard reports 0.0013 Al_2O_3 in Humboldt River water taken at Battle Mountain, Nevada (see also Mon. 11, p. 41).

Of the analyses of American springs, two, which should be noted, contained alumina. These are the following: artesian well, "Glacier Spouting Spring," Saratoga, N. Y., analyzed by F. A. Cairns and C. F. Chandler (Amer. Chemist, 1872, Nov., p. 164), containing 0.00770 part Al_2O_3, and artesian well, Sheboygan, Wis., analyzed by C. F. Chandler (Amer. Chemist, 1876, p. 370), containing 0.0022 part per 1000 parts in both cases.

Russell states also that O. Loew (Ann. Rpt. Chief Engineers, 1876, Appendix JJ, p. 410) reports an analysis of the water of Owens Lake, California, noting a trace of aluminium.

According to data quoted by Russell (loc. cit.) Terreil (Larted, Geological Explorations of Dead Sea, p. 278) found that the Dead Sea water contains traces of alumina.

Say, M. (Wien. Acad. Ber., 13, pp. 298 and 457; Pharm. Centbl., 1854, p. 923; Jahresb. Chem , 1854, p. 771), reports (grams per 1000 gms.) in Hildegarde spring-water from Ofen 0.047, and in mineral water from Lippa 0.0157, both towns in Hungary.

Scherer (Ann. Chem. Pharm., 99, p. 257; Vierteljahressch. Prakt. Pharm., 6, p. 81; Jour. Prakt. Chem., 70, p. 151; Chem. Centbl., 1856, p. 810; Jahresb. Chem., 1856, p. 767) found 0.0002 gm. alumina per 1000 cc. in Wernarzer mineral water, and a trace in the sweet potable water near the Sinnbergerquelle, both waters from Brückenau, Germany.

Scherer (Neue. Jahrb. Pharm., 7, p. 309; Jahresb. Chem. 1857, p. 721) notes a trace of alumina in the saline water from Philippsquelle at Orb, Germany.

Scherfel, A. (Ungar. Naturw. Ber., 1, p. 195; Jahresb. Chem., 1886, p. 2321), notes 0.002349 part $AlPO_4$ and 0.019317 part Al_2O_3 per 1000 parts in water from a spring at Kirchdrauf in der Zips, Szepesváralja, Hungary.

Scherfel, A. (Ungar. Naturw. Ber., 1, p. 230; Jahresb. Chem., 1886, p. 2322), notes 0.014722 part $AlPO_4$ and 0.017778 part Al_2O_3 per 10,000 parts in mineral water from Czeméte near Eperies, Hungary.

Schmidt, C. (Arch. Naturk. Liv. Esth. Kurlands., 1st ser., 1, p. 293; Jahresb. Chem., 1854, p. 771), notes a trace of alumina in the bored saline-spring water from Staraja-Russa, Russia.

Schmidt, C. (Mélanges Phys. et. Chim. tirées Bul. Akad. Imp. Sci. St. Petersburg 7, p. 427; Petersburg Acad. Bul. 12, p. 1; Jahresb. Chem., 1867, p. 1042), notes 0.021 part alumina per 10,000 parts in iron water from Stolypin, Russia. Alumina was not noted in the deposit from the water.

Schneider, F. C. (Wiener. Akad. Ber., 2. Abt., 69, p. 55; Jahresb. Chem., 1874, p. 1330), reports 0.010, 0.006, 0.015, and 0.011 part alumina per 10,000 parts, respectively, in four St. Helena thermal springs at Battaglia, Italy.

Schröckinger (Verhandl. Geol. Reichsans., 1878, p. 89; Jahresb. Chem., 1878, p. 1301), reports 0.0044 part aluminium phosphate per 10,000 parts in water from a bored well 127 meters deep, near Brüx, Bohemia. The analysis was made by Gintl.

Schoeller, R. (Ber. Deut. Chem. Gesellsch., 20 (1887), p. 1784; Jahresb. Chem., 1887, p. 2537), reports analyses of streams affecting the Rio de la Plata water. That designated Uruguay water contained 0.0018 gm. alumina per 1000 gm.

Schwarz, E. (Wiener Akad. Ber., 55, 2. Abt., p. 35; Wiener Akad. Anz., 1867, p. 7; Chem. Centbl., 1867, p. 558, Inst., 1867, p. 151; Jahresb. Chem., 1867, p. 1037), notes 0.007 part aluminium phosphate per 10,000 parts in mineral water from Mödling near Vienna.

Schweissinger (Chem. Centbl., 1890, I, p. 875; Jahresb. Chem., 1890, p. 2662) notes a trace of alumina in the Bad Marienborn iron-sulphur water.

Shepard, C. U. (Silliman's Amer Jour., 2d ser., 47, p. 357; Jahresb. Chem., 1869, p. 1293), reports 0.0000093 part calcium, iron, and aluminium phosphate per 100 parts in artesian water from Charleston, South Carolina.

Siegmund, H., and **P. Juhász** (Wiener Akad. Ber., 54, 2. Abt., p. 216; Wiener Akad. Anz., 1866, p. 162; Inst., 1866, p. 400; Jahresb. Chem., 1866, p. 996) found 0.002 part aluminium phosphate per 10,000 parts in the Vöslau mineral water.

Simmler, T. (Jour. Prakt. Chem., 71, p. 1; Chem. Centbl., 1857, p. 498; Jahresb. Chem., 1857, p. 723), found 0.0046 gm. alumina with phosphoric acid per 1000 gm. in sulphur-water from Stachelberg, Canton Glarus, Switzerland.

Smith (Jour. Chem. Soc. London, 15 (1862), p. 57; Jour. Prakt. Chem., 89, p. 186; Chem. News, 5, p. 96; Rép. Chim. Appliquée, 4, p. 216; Jahresb. Chem., 1862, p. 822) found in the water of the Te Tarata hot spring on the coast of Rotomahana, north New Zealand, 0.32 grain alumina per gallon.

Smith (Jour. Prakt. Chem., 89 (1863), p. 186; U. S. Geol. Survey Rpt. 9, p. 655) notes 0.005 gm. alumina per kilogram in White Terrace Geyser water from New Zealand.

Smith, L. (Silliman's Amer. Jour., 2d ser., 12, p. 10; Jahresb. Chem., 1851, p. 668), reports aluminium sulphate in mineral water from Brusa (Asia Minor) as follows: Kukurtlu 0.0043 and Bademli Baghtsche 0.0020 gm. per 1000 cc., and Gueuzayasma a trace. He reports further (Silliman's Amer. Jour., 2d ser., 12, p. 366; Jour. Prakt. Chem., 55, p. 110; Jahresb. Chem., 1851, p. 668) a trace of aluminium sulphate in the Yalova hot spring, and 0.0221 gm. aluminium sulphate per 1000 cc. in the Touzla Spring water.

Smoot, L. E. (Amer. Chem. Jour., 19 (1897), p. 234; Jour. Chem. Soc. London, 72 (1897), II, p. 329), notes 0.891 gm. Al_2O_3 per liter in an alum-water from Lee County, Virginia.

Soubeiran, E. (Jour. Pharm., 3d ser., 32, p. 19; Jahresb.

Chem., 1857, p. 726), found 0.054 gm. alumina and silica per 1000 cc. in Vic-sur-Cère mineral water, Cantal, France.

Späth, E. (Chem. Centbl., 1889, II, p. 896; Jahresb. Chem., 1889, p. 2636), notes traces of Al_2O_3,P_2O_5 in Temple and Wiesen Spring water from Bad Steben at Oberfranken.

Spengler quotes F. Mohr's analysis of the Felsenquelle of Ems (Arch. Balneologie, 3 (1864), p. 136; Viertelj. Prakt. Pharm., 14, p. 234; Chem. Centbl., 1865, p. 608; Jahresber. Chem., 1865, p. 931). A pound (7680 grains) contained 0.0960 grain alumina.

Spica, P. (Gaz. Chim. Ital., 12 (1882), p. 555; Jahresb. Chem., 1882, p. 1623), noted traces of Al_2O_3 in two samples of water from Lake Derkol near Constantinople.

Spica, P. (Gaz. Chim. Ital., 22 (1892), I, p. 354; Jahresb. Chem., 1892, p. 2686), notes 0.001999 gm. aluminium phosphate per 1000 cc. in mineral water from Burge Malo.

Spurr, J. E. (U. S. Geol. Survey Mon. 31, p. 212), quotes an analysis by C. F. Chandler of water from Yampa Spring, Glenwood Springs, Colorado. This contained a trace of alumina.

Stackmann, A. (Russ. Ztschr. Pharm., 24, pp. 129, 145, 161, 209, 225, 273, 289, 321, 337; Jahresb. Chem., 1885, p. 2319), reports analyses of mineral water from Psekoup or Gorjatschy Kljutsch. Data are quoted for (1) Alexanderquelle, (2) Olgaquelle, (3) Marienquelle, (4) Karmalinquelle, (5) Michailquelle, (6) Kamenewquelle, (7) Südliche Drainagequelle, (8) spring without particular name, and (9) mixture of above eight waters. These contained respectively 0.0010, 0.0005 0.0005, 0.0005, 0.0007, 0.0009, 0.0010, 0.0005, and 0.0012 Al_2O_3 (presumably grams per 1000 cc.). The author also reports 0.0050 gm. Al_2O_3 per 1000 cc. in a sulphur spring and 0.0390 gm. Al_2O_3 per 1000 cc. in a saline spring analyzed by him.

Steiger, G. (U. S. Geol. Survey Bul. 113, p. 113), in water from American Carlsbad Spring, Nashville, Illinois, found 3.60 parts Al_2O_3 per 1,000,000.

Stein, W. (Schmidt's Jahrb. Ges. Med., 70, p 142; Jahresb. Chem., 1851, p. 654), notes traces of alumina in the medicinal waters of Elster, Saxony, as follows: Gasquelle, Salzquelle or Augenquelle, and Trinkquelle or Stahlbrunnen.

Steinbrück (Arch. Pharm., 2d ser., 145 (1871), p. 97; Jahresb. Chem., 1871, p. 1228) reports 0.0212 and 0.0134 gm. Al_2O_3 per liter in two springs at Neuragoczi near Halle.

Stieren, E. (Vierteljahressch. Prakt. Pharm., 10, p. 365; Jahresb. Chem., 1861, p. 1112), notes 0.040830 part alumina per 1000 parts in artesian water from Peterson's saline water, Tarentum, Pennsylvania.

Strecker, A. and **H.** (Chem. Lab. Univ. Christiana, 1854, p. 67, Ann. Chem. Pharm., 95, p. 177; Jahresb. Chem., 1854, p. 770), in the sulphur-water of Sandefjord found 0.0068 part alumina per 1000 parts, and 0.0033 parts in near-by sea-water.

Streit, S., and **W. Holeček** (Wiener Akad. Ber., 53, 2. Abt., p. 371; Jahresb. Chem., 1866, p. 995) note 0.021 and 0.0067 part aluminium phosphate per 10,000 parts, respectively, in Töplitz and Someraubad mineral water from Mähren.

Thresh, J. C. (Chem. News, 46, p. 226; Jahresb. Chem., 1882, p. 1635), found 10.416 gms. $Al_2S_3O_{12}$ and 0.065 gm. $AlPO_4$ per 10,000 cc. in the Orchard Alum Spring water, England.

Thresh, J. C. (Jour. Chem. Soc. London, 41 (1882), p. 117), in Buxton thermal water reports 0.000683 $Al_2O_3.Ca_3(PO_4)_2$ per 10,000 gms. He notes that in 1852 Playfair reported 0.034 part $Al_2O_3.Fe_2O_3$ per 10,000 parts in the same water.

Thörner, W. (Repert. Analyt. Chem., 3, p. 22; Jahresb. Chem., 1883, p. 1944), reports in a bored well (Soolquelle) at Melle, Germany, 0.000102 part Al_2O_3 per 1000 parts.

Thörner, W. (Ztschr. Angew. Chem., 1889, p. 309; Jahresb. Chem., 1889, p. 2631), reports 0.0020 gm. alumina per 1000 cc. in water from the Germania Spring at Schwalheim, Germany.

Thörner, W. (Chem. Ztg., 17, p. 1411; Jour. Chem. Soc. London, 66 (1894), II, p. 195), reports Al_2O_3 as follows in some German mineral-spring waters: Stahl 0.0132, Angelika at Tönnisstein 0.0056, Wilhelms 0.0679, New Spring at Melle 0.0045, and Sulphur Spring at Levern 0.0020 gm. per liter.

Thorpe, T. E. (Jour. Chem. Soc. London, 65 (1894), p. 772), reported analyses of a number of mineral waters from Cheltenham, England. The Chadnor Villa well contained 0.00015 part aluminium phosphate per 1000 parts, and the Lansdowne well and the Pittville wells, Nos. 1, 2, and 3, each traces.

Tissandier, G. (Compt. Rend. Acad. Sci. Paris, 80, p. 58; Jahresb. Chem., 1875, p. 1284), reports a trace of Al_2O_3 in melted snow collected in Paris and in the country.

Tournaire (Ann. Minn., 5th ser., 17, p. 65; Jahresb. Chem., 1860, p. 841), reported 0.165 gm. $Al_2O_3.SiO_2$ in mineral water from Roddes (France), near Ambert.

Tournaire (Ann. Minn., 5th ser., 17, p. 66; Jahresb. Chem., 1860, p. 841) found 0.055 gm. $Al_2O_3.SiO_3$ per 1000 cc. in a mineral water from Ceyssat, Dept. Puy-de-Dôme, France.

Treadwell, F. P. (Arch. Pharm., 231 (1893), p. 579; Jour. Chem. Soc. London, 66 (1894), II, p. 323), in the upper spring of Gyrenbad, Canton Zürich, found 0.000200 part $AlPO_4$ per 10,000 parts.

Trillich, H. (Chem. Ztg. II. Rept., p. 211; Chem. Centbl., 1887, p. 1239; Jahresb. Chem., 1887, p. 2534), notes 0.00109 gm. aluminium phosphate per 1000 gms. in the sulphur-water of Bad Wemding at Ries.

Trillich, H. (Chemische Analyse des Hauptbrunnens zu Münster a. Stein, Munich; Chem. Centbl., 1889, II, p. 896; Ausz.; Jahresb. Chem., 1889, p. 2631), notes 0.00168 part Al_2O_3 per 1000 parts in water from the Hauptbrunnen at Münster, Germany.

Tschermak (Jahrb. K. K. Geol. Reichsanstalt, 1858, p. 297; Jahresb. Chem., 1858, p. 796) found 0.0092 part aluminium phosphate per 1000 parts in mineral water from Kondran near Regensburg, Germany.

Tschermak, T. (Min. Petr. Mitth., 2d ser., 3, p. 315; Jahresb. Chem., 1880, p. 1528), quotes analyses made by P. Schnell and Stenner in 1855 of water from an iron spring at Slanik, Roumania. This contained 0.07 gm. Al_2O_3 per 10,000 gms.

Turner, T. (Chem. News, 49, p. 186; Jahresb. Chem., 1884, p. 2036), reports 0.0740 gm. Al_2O_3 (with some Fe_2O_3) per 1000 cc. in water from the salt wells of Dudley, England.

Valentiner, W. (Jour. Prakt. Chem., 99, p. 91; Jahresb. Chem., 1866, p. 994), in Oberbrunnen and Mühlbrunnen mineral waters from Ober-Salzbrunn reports per 1000 parts, 0.005 and 0.0003 part aluminium with phosphoric acid, respectively.

Vierthaler, A. (Wiener Akad. Ber., 56, 2. Abt., p. 463; Wiener Akad. Anz., 1867, p. 220; Jour. Pharm. Chem., 102, p. 381; Jahrb. Chem., 1867, p. 1040), reports traces of alumina in the Cattani No. 2 and San Francesco springs of Spalato.

Vohl, H. (Dingler's Polytech. Jour., 199, p. 311; Chem. Centbl., 1871, p. 269; Arch. Pharm., 2d ser., 146 (1871), p. 199; Jahresber. Chem., 1871, p. 1223), reports 0.0008 gm. Al_2O_3 per 10,000 cc. in one sample and 0.010 gm. in five samples of Rhine water taken under different circumstances near Cologne.

Vohl, H. (Ber. Deut. Chem. Gesellsch., 1875, p. 611; Arch. Pharm., 3d ser., 7, p. 134 (see under R. Bender); Jahresb. Chem., 1875, p. 1290), notes 0.0556 gm. alumina per 10,000 cc. in Birresborn mineral water.

Vohl, H. (Ber. Deut. Chem. Gesellsch., 1876, p. 20; Jahresb. Chem., 1876, p. 1298), reports 0.3925 gm. alumina per 10,000 cc. in Birresborn mineral water taken after the spring had been cleaned.

Vohl, H. (Ber. Deut. Chem. Gesellsch., 11 (1878), pp. 605, 877: Jahresb. Chem., 1878, p. 1299; Jour. Chem. Soc. London, 34 (1878), II, p. 714), notes in Gerolsteiner Schlossbrunnen, located near Pelm, Germany, 0.0002 part Al_2O_3 per 1000 parts, and in Birresborn spring-water from the same locality traces of alumina.

Vohl, H. (Ber. Deut. Chem. Gesell., 11 (1878), p. 1678; Jahresb. Chem., 1878, p. 1304), reports 0.3067 part Al_2O_3 per 10,000 parts in Ofener Rakoczy Bitterwasser. He quotes C. R. C. Tichborn's analysis, which gave 0.27 part Al_2O_3 per 10,000 parts, and J. Mólnar's, which gave 0.4840 part Al_2O_3 per 10,000 parts. The water varies in composition at different seasons, etc.

von der Marck, W. (Arch. Pharm., 2d ser., 102 (1860), p. 1; Vierteljahressch. Prakt. Pharm., 9, p. 161; Chem. Centbl., 1860, p 485; Ztschr. Chem. Pharm., 1860, p. 170; Jahresb. Chem., 1860, p. 831), reports 0.00676 gm. alumina per 1000 in the Stahlbrunnen, one of the Hermannsborn mineral springs near Pömbsen, Germany.

Wait, F. G. (Rpt. Section of Chem. and Mineral., Geol. Survey Canada, 1898, p. 48 R), reports 0.345 part alumina per 1000 in the filtered water from Lake Goodenough, a soda lake in British Columbia. It was calculated that this represented 0.825 part aluminium phosphate or 64.016 grains per imperial gallon.

Wait (Geol. Survey Canada, Chem. Contributions, 1892–93, p. 78 R) notes 0.0002 part alumina with a little ferrous oxide per 1000 parts in water from a bored well 1943 feet deep near Deloraine, Manitoba.

Wallace (Analyst, 1880, p. 79; Jahresb. Chem., 1880, p. 1535) notes 8.0 parts Al_2O_3 per 1,000,000 in an English artesian water.

Wallace (Rept. British Assoc., 1862, Notices and Abstracts, p. 94; Jahresb. Chem., 1862, p. 818) found alumina and phosphate as follows: Loch Katrine water (thirty-five miles from Glasgow) 0.10, and the same water at Glasgow 0.16 grain per gallon.

Walton, G. E., in his volume on mineral waters of this country and Canada (The Mineral Springs of the United States and Canada, New York, 1883) quotes a number of analyses in which alumina was reported. Such data (unless noted from other sources) are included in the table on the next page.

Walz, G. F. (Neue. Jahrb. Pharm., 6, p. 265; Jahresb. Chem., 1856, p. 769), found 0.0010 gm. alumina per 1000 gm. in sulphur-spring water from Weisloch, Baden, the sample being taken at the spring-house. In a sample taken after flowing one-eighth mile through a pipe the water contained 0.0009 gm. alumina per 1000 gms.

Wandesleben (Neue Jahrb. Pharm., 3, p. 123; Pharm. Centbl., 1855, p. 361; Jahresb. Chem., 1855, p. 840) notes 0.0013 gm. alumina per 1000 gms. in Oestringer sulphur-water from Langenbrücken, Baden.

Weed, W. H., and **L. V. Pirsson** (U. S. Geol. Survey Bul. 139, p. 150) quote an analysis of White Sulphur Springs, Montana, which records a trace of alumina.

MINERAL WATERS OF THE UNITED STATES AND CANADA.

Spring.	Analyst.	Page.	Al_2O_3 per Pint.	Aluminium Sulphate per Pint.
			Grains.	Grains.
California Seltzers Spring.	H. G. Hanks	148	.075	
Versailles, Ill., Curry Spring. . .	J. V. Z. Blaney	149	.091 *a*	
Caledonia, Ontario, Gas Spring	T. Sterry Hunt	164	.032	
Caledonia, Ontario, Saline Spring.	T. Sterry Hunt	164	trace	
Caledonia, Ontario, Intermittent Spring.	T. Sterry Hunt	164	trace	
Caledonia, Ontario, sulphur-water	T. Sterry Hunt	183	.019	
Big Bone Kentucky springs . . .	. . . .	193	. . . .	*b*
Berkshire, Mass., Soda spring.	. . . .	335	*b*	
Caxton, Quebec, spring	T. Sterry Hunt	389	.036	
Slatersville, N. Y., spring	B. Hitchcock	399	*b*	
Excelsior, Mo., springs	. . . .	418	*b*	
South Park, Col., spring.	G. E. Patrick	450	.047	

a. With trace of iron.
b. Qualitative analysis—amount not stated.

Weidel, H., and **G. Goldschmiedt** (Wiener Acad. Ber., 2. Abt., 74, p. 391; Jahresb. Chem., 1877, p. 1386) report 0.0063 part Al_2O_3 per 10,000 parts in O Tura Säuerling water from Hungary.

Wertheim, T. (Wiener Acad. Ber., 42, p. 479; Rép. Chim. pure, 3, p. 131; Jahresb. Chem., 1860, p. 836) notes 0.02899 part alumina per 10,000 parts in Franz-Joseph-Bad water from Tüffer, Austria.

Weselsky, P., and **A. Bauer** (Wiener Acad. Ber., 29, p. 585; Chem. Centbl., 1858, p. 652; Jahresb. Chem., 1858, p. 797) note 0.00227 part alumina (with phosphoric acid?) per 1000 parts in water from the König Ferdinand Eisenbad, Weidritzthal near Presburg, Hungary.

Wiggers (Bal. Ztg. 1, p. 4; Pharm. Centbl., 1854, p. 934; Jahresb. Chem., 1854, p. 762) notes that a potable water from a spring at Hofgeismar, Hesse-Nassau, Germany, contained a trace of alumina too small to weigh.

Wiggers (Arch. Pharm., 2d ser., 102, p. 215; Jahresb. Chem., 1860, p. 832) found 0.001920 grain alumina per pound (=7680 grains) in the Driburg, Germany, mineral water.

Wildenstein, R. (Jour. Prakt. Chem., 85, p. 100; Chem. Centbl., 1862, p. 200; Jahresb. Chem., 1862, p. 810), notes 0.00180 part aluminium phosphate per 10,000 parts in water from a hot mineral spring a Burtscheid, Germany.

Will (Ann. Chem. Pharm., 61, p. 181; Pharm. Centbl., 1847, p. 507; Jahresb. Chem., 1847–48, p. 1002) eports in water from Rippoldsau as follows: Josephsquelle 0.0953, Wenzelsquelle 0.0840, and Leopoldsquelle 0.0822 gm. alumina per 10,000 gms.

Will (Ann. Chem. Pharm., 81, p. 73; Pharm. Centbl., 1852, p. 237; Jahresb. Chem., 1851, p. 650) found 0.00119 part aluminium phosphate per 1000 parts in sulphur-water from Weilbach.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 86, p. 543; Bul. Soc. Chim., 2d ser., 29, p. 291; Jahresb. Chem., 1878, p. 1309), notes in Aix-les-Bains (Savoy) sulphur spring 0.0013 gm. aluminium per liter, and in the alum-spring water 0.0003 gm. $Al_2S_3O_{12}$ per liter.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 86, p. 613; Jour. Chem. Soc. London, 34 (1878), II, p. 560), analyzed mineral water from Challes, Savoy, reporting 1.21851 and 0.3306 gm. per liter soluble matter in Source principale and Petite Source, the former containing 0.0059 gm. alumina and the latter 0.0232 gm. alumina and sand together.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 90, p. 547; Jahresb. Chem., 1880, p. 1534), reports an analysis of the Richard spring at Cransac, France. April 15, 1879, the water contained 0.02800 gm. $Al_2S_3O_{12}$, and July 14, 1879, 0.1760 gm. per 1000 cc.

Willm, E. (Bul. Soc. Chem., 2d ser., 31, p. 3; Jahresb. Chem., 1879, p. 1266), reports 0.0027, 0.0024, and 0.0012 gm. alumina per 10,000 cc., respectively, in three Auvergne mineral waters, and traces in three others.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 90, p. 630; Jahresb. Chem., 1880, p. 1533), analyzed the Bussang springs in the Vosges. Salmade contained 0.0012, Ober Quelle 0.011, and Quelle Marie 0.0010 gm. Al_2O_3, respectively, per 1000 cc.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 103, p. 416;

Jour. Chem. Soc. London, 50 (1886), p. 997, notes 0.0003 gm. alumina per liter in the Bosquet water of Bagnères de Luchon, Haute Garonne.

Willm, E. (Compt. Rend. Acad. Sci. Paris, 113, p. 87; Jahresb. Chem., 1891, p. 2617), notes per 1000 cc. in Madeleine water No. 1 0.0644, in Madeleine water No. 2 0.0248, in Cercle water 0.0154, in Damont water 0.0963, and in Des demoiselles spring 0.0399 aluminium sulphate. These springs are at Rennes-les-Bains (Aude). The first three belong to a company; the last two to the town.

Wittstein (Vierteljahressch. Prakt. Pharm., 10, p. 342; Jahresb. Chem., 1861, p. 1097) reports Al_2O_3 in water as follows: Ohe River 0.00017, Höhenbrunnerfilz 0.00076, Schliessheimer moor water 0.00029, Isar River 0.00030, and Brunnthaler water 0.00013 gm. per 1000 gms.

Wolff, J. (Wiener Akad. Ber., 56, 2. Abt., p. 55; Wiener Akad. Anz., 1867, p. 137; Jour. Prakt. Chem., 101, p. 318; Chem. Centbl., 1867, p. 424; Inst., 1867, p. 391; Jahrb. Chem., 1867, p. 1039), reports 0.0064 part alumina and phosphoric acid per 10,000 parts in water from the mineral spring at Siebenbürg.

Wreden, F., and **A. Fuchs** (Ber. Deut. Chem. Gesellsch., 1874, p. 1147; Jahresb. Chem., 1874, p. 1335) note in "5 per cent Soljanka" mineral water and water from an artesian well, both at Ciechocinek, Poland, 0.0035 and 0.0101 part $Al_2(HO)_6$ per 1000 parts, respectively. A salt obtained from the "5 per cent Soljanka" water was analyzed and found to contain 0.0314 per cent Al_2O_3. Dried at 110° the salt contained 1.005 per cent material which was not soluble in water.

Wroblewsky, E. (Bul. Soc. Chim., 2d ser., 30, p. 436; Ber. Deut. Chem. Gesell., 1878, p. 1848 (corresp.); Jahresb. Chem., 1878, p. 1314), reports 0.02119 part Al_2O_3 per 1000 parts in a spring near Ekaterinodar in the Caucasus.

Wurtz, H. (Silliman's Amer. Jour., 2d ser., 22, pp. 124, 301; Jahresb. Chem., 1857, p. 729), notes a trace of alumina in Delaware River water taken near Trenton, New Jersey.

Zaleski, S. S. (Chem. Ztg., 1892, p. 594; Jahresb. Chem., 1892, p. 2683), notes 0.0018 part Al_2O_3 per 1000 parts in Ingol Lake water, Gouv. Jenissejsk.

Zäugerle, M. (Neue. Repter. Pharm., 14, p. 9; Chem. Centbl., 1865, p. 798; Jahresber. Chem., 1865, p. 933), reports traces of alumina in the Schillingsforst spring, Bavaria.

ALUMINIUM IN MISCELLANEOUS MATERIALS.

Corney, B. G., D. Guthrie, and **F. B. Guthrie** (Jour. and Proc. Roy. Soc. New South Wales, 33 (1900), p. 224; Jour. Chem. Soc. London, 78 (1900), II, p. 569) note the presence of 41.53 per cent Al_2O_3 in an edible earth from Fiji. The earth is regarded as a silicate with the formula $Al_2O_3(SiO_2)_2(H_2O)_2$, with Fe_2O_3 present as an impurity.

Hebberling, M. (Vierteljahressch. Prakt. Pharm., 18, p. 558; Dingler's Poly. Jour., 194, p. 88; Chem. News, 20, p. 249; Jahresb. Chem., 1869, p. 1119), analyzed earth from Berbek, Java, which is eaten by the natives. He found 25.939 per cent alumina.

Love, E. G. (Chem. News, 41, p. 187; Jahresber. Chem., 1880, p. 1118), reports the analysis of a Japanese edible earth. This contained 13.61 per cent alumina.

Muir, M. M. P. (Chem. News, 36, p. 202; Jour. Chem. Soc., London, 34 (1878), II, p. 120), notes 17.97 per cent Al_2O_3 in an edible clay from Mackenzie County (South Island), New Zealand. He states that this clay is largely eaten by sheep.

Schmidt, C. (Ann. Chim. Phys., 4th ser., 26, p. 535; Jour. Chem. Soc. London, 26 (1873), p. 151), in an article on Eatable Earths of Lapland and Southern Persia, notes 40.797 per cent alumina in earth eaten in Lapland. The specimen came from the village of Ponoï. Alumina was not reported in the earth from Kirman (called G'hel i G'iveh) in Southern Persia.

Stark, J. F. (Chem. News, 23, p. 199; Jour. Chem. Soc. London, 24 (1871), p. 425), reports 4.17 per cent Al_2O_3 in an earth-ball from a horse. The ball weighed over two pounds.

The principal constituent of the earth-ball was ammonium-magnesium phosphate, which amounted to 83.2 per cent.

Thompson, W. Gilman (Practical Dietetics, New York, 1902, p. 281), notes the occasional use of alum and aluminium chloride as preservatives. This use of aluminium compounds has also been noted by other writers.

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